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United States Air Force

BIOVENTING AT OPERABLE UNITS 5, 8, 9, 10, AND 11

DRAFT

Loring Air Force Base
SEMIANNUAL PERFORMANCE REPORT

January–June 1998

November 1998

Revision C

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United States Air Force

Bioventing at Operable Units 5, 8, 9, 10, and 11

DRAFT

Loring Air Force Base

SEMIANNUAL PERFORMANCE REPORT

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November 1998

Revision C

Loring Air Force Base

BIOVENTING AT OPERABLE UNITS 5, 8, 9, 10, AND 11

SEMIANNUAL PERFORMANCE REPORT

January–June 1998

DRAFT

Prepared for:
Department of the Air Force
Air Force Center for Environmental Excellence (AFCEE)
Brooks Air Force Base, Texas 78235-5328

Prepared by:
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Contract No. F41624-94-D-8072
Job No. 22784

November 1998
Revision C

Prepared	Jeff W. Sims	11/10/98 Date
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Approved	for R.L. Patterson BEI Project Manager	11/10/98 Date

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CONTENTS

Page

FIGURES

TABLES

ACRONYMS AND INITIALISMS

AFB	Air Force Base
AFCEE	Air Force Center for Environmental Excellence
AHS	Auto Hobby Shop
AIW	air injection well
BEI	Bechtel Environmental, Inc.
bgs	below ground surface
BV	biovent points
BXSS	Base Exchange Service Station
COE	U.S. Army Corps of Engineers
ES	Entomology Shop
FJETC	Former Jet Engine Test Cell
FTA	Fire Training Area
FTF	Fuel Tank Farm
GAC	granular-activated carbon
MP	monitoring point
NDA	Nose Dock Area
O&M	operations and maintenance
OU	operable unit
PLC	programmable logic control
PPDP	Power Plant Drainage Pipe
PRG	preliminary remediation goal
TPH	total petroleum hydrocarbon
TVH	total volatile hydrocarbon
VM	vapor monitoring point
VMB	Vehicle Maintenance Building

UNITS OF MEASURE

ft	foot
ft^3	cubic foot
kg	kilogram
lb	pound
mg	milligram
ppm	parts per million
ppmv	parts per million volatiles
psi	pounds per square inch
scfm	standard cubic feet per minute

1.0 INTRODUCTION

This semiannual bioventing report presents information gathered from operation and maintenance (O&M) activities performed by Bechtel Environmental, Inc. (BEI) on the bioventing systems at Loring Air Force Base (AFB), Maine. Work was conducted under Contract No. F41624-94-D-8072, Delivery Order 0005, for the Air Force Center for Environmental Excellence (AFCEE). This report covers the of O&M activities at 16 bioventing systems from January 1 through June 30, 1998. Table 1-1 summarizes operations at each bioventing site, including the number of air injection wells (AIWs), monitoring points (MPs), and oxygen sensors. Table 1-1 also includes the oxygen utilization rate ranges determined from field tests performed during the summer and fall 1996, spring and fall 1997, and spring 1998 respiration tests at each site.

The objective of this report is to present operations data and an evaluation of bioventing system performance, including site status, problems identified, and recommendations. Operations guidelines, summarized in Figure 1-1, facilitate identification of required system changes during normal operations and when remediation is nearing completion.

A pilot-scale treatability study at the Base Exchange Service Station (BXSS) (Earth Tech 1995) indicated that bioventing was a viable remedial technology for petroleum-contaminated soils at Loring AFB. The BXSS treatability study report presented preliminary information and established basic design parameters. Based on the BXSS treatability study, bioventing was selected as the preferred removal action treatment technology at 16 sites in 5 operable units (OUs) at Loring AFB. Bioventing systems were installed and started at four sites in the fall of 1995:

- Former Jet Engine Test Cell (FJETC)
- Fire Training Area (FTA)
- Power Plant Drainage Pipe (PPDP)
- Vehicle Maintenance Building (VMB)

These four units were turned over to AFCEE on February 1, 1996, with BEI performing O&M. At the same time, BEI also took over O&M for the BXSS site, which had been operating since the fall of 1993. The U.S. Army Corps of Engineers (COE) installed additional MPs and AIWs and made system modifications at the BXSS site during the summer and fall of 1996.

The other 11 sites were constructed and began operation in the fall of 1996. BEI began performing O&M for these units on December 1, 1996. These 11 sites are:

- Auto Hobby Shop (AHS)
- Entomology Shop (ES)
- Fuel Tank Farm (FTF)
- Nose Dock Areas (NDA) 1 through 8

Table 1-1
Biovent System Summary

Site	Number of AIWs	Total Number of MPs[2]	Number of O_2 sensors[2]	Total operation (days)[3]	O_2 utilization rate %/hr[4]
AHS	19	20	5	575	0.04-7.5
BXSS	7	12	0	833	0.08-1.3
ES	7	13	1	620	0.01
FJETC	13[1]	8	1	699	0.08 - 0.72
FTA	16	38	1	820	0.04-1.54
FTF	20	15	4	344	0.4-3.03
FTF II	37	17	7	253	0.01-2.8
NDA-1	24	10	1	580	0.11-5.1
NDA-2	23	10	1	564	0.7
NDA-3	21	5	1	603	not tested[5]
NDA-4	36	15	1	527	0.05-0.77
NDA-5	29	7	1	526	0.05-7.2
NDA-6	4	4	2	609	0.1
NDA-7	4	2	1	605	not tested[5]
NDA-8	23	3	1	611	not tested[5]
PPDP	18	24	1	804	0.05-1.7

[1]Two wells which never registered any flow were replaced in July 1997.
[2]Number of MPs represents the total number of MPs (with and without oxygen sensors).
[3]As of June 30, 1998.
[4]Range of values from summer and fall 1996, spring and fall 1997, and winter and spring 1998 measurements. Respiration test ranges for each MP tested are presented in Section 3.1.
[5]Not tested due to high water and/or no air flow.

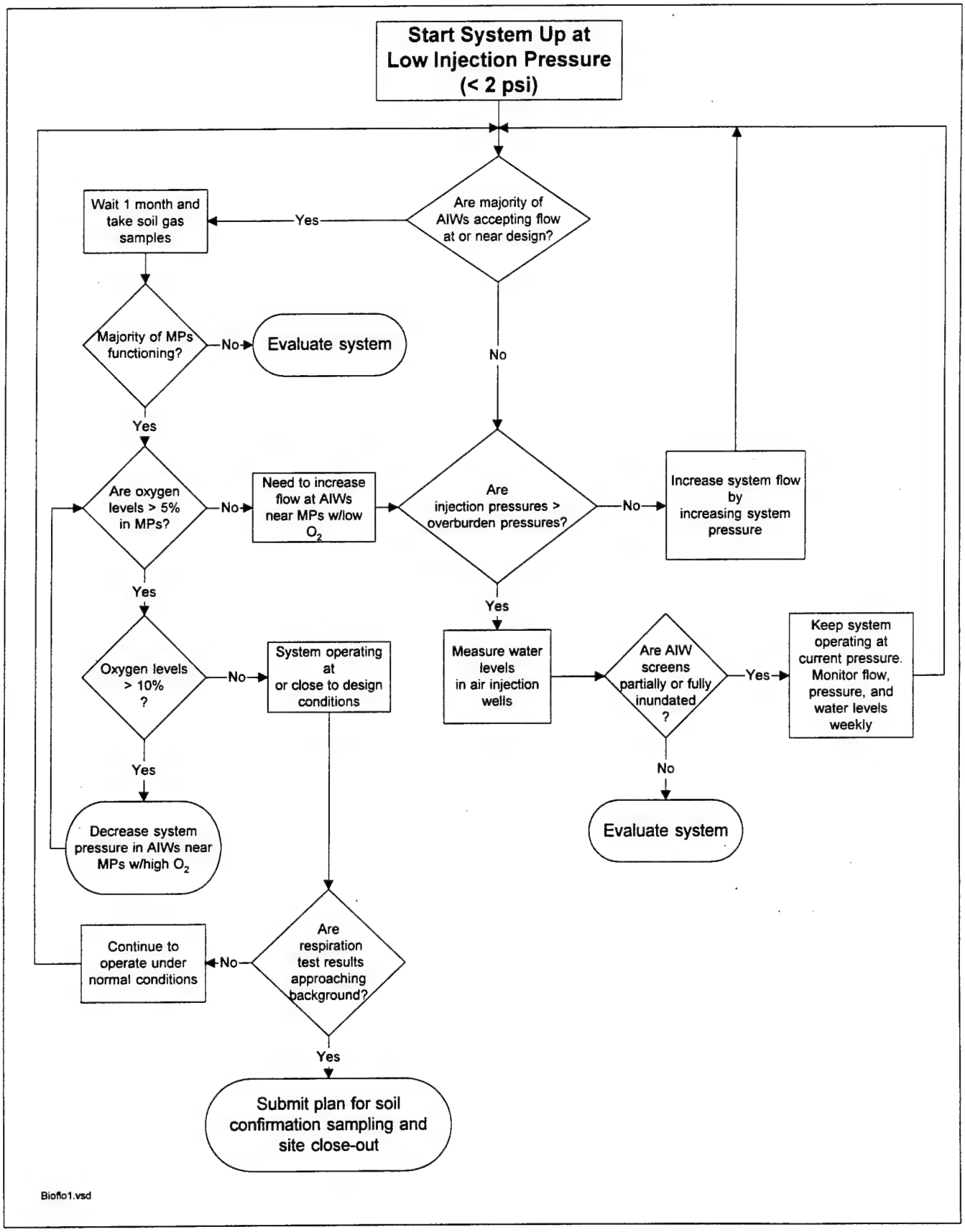


Figure 1-1 Bioventing Process Operation Decision Chart

An additional bioventing system constructed at the FTF (designated FTF II) during June through August 1997 began operation on August 28, 1997. The installation documentation (e.g., geologic logs, monitoring well completion logs, and as-built drawings) is included in *Bioventing at Operable Units 5, 8, 10, and 11, Removal Action Report,* Addendum 2.

Experience gained at Loring AFB enhances understanding of how the biovent systems operate in relationship to site-specific hydrogeology. Figure 1-2 is a conceptual model of a typical bioventing site. In general, each site consists of glacial till (either natural and/or worked) and lenses of higher-permeability material (e.g., gravel, sand) containing perched water. The overburden groundwater table is usually below the area being treated by bioventing, so most groundwater influences on air injection are likely caused by perched groundwater (historic water table depths determined the depths of the screens). Perched water also affects the collection of soil gas samples in MPs.

Advective air flow occurs primarily in regions of higher permeability. In regions of lower permeability, soils are aerated through diffusive transport. Even when soil gas samples cannot be drawn, it is likely that aeration is occurring and supporting biodegradation, but at a reduced rate.

Documents pertaining to bioventing system design, testing, installation, and O&M include:

- *Final Remedial Investigation Reports, Operable Units 5, 8, 9, 10, and 11* (CDM 1996, ABB-ES 1995a, ABB-ES 1995b, ABB-ES 1994, ABB-ES 1996, respectively)
- *Test Plan and Technical Protocol for a Field Treatability Test for Bioventing* (AFCEE 1992)
- *Long-Term Bioventing Treatability Study, Loring AFB, Base Exchange Service Station* (Earth Tech 1995)
- *Operation and Maintenance Manuals for Nose Dock Area & Service Station* (Patrick St. Peter & Sons Inc. 1997)
- *Design Analysis Report, Operable Units 5, 9, 10, and 11* (URS 1995a)
- *Bioventing and Excavation Specifications for Former Jet Engine Test Cell, Fuel Tank Farm, Vehicle Maintenance Building, Power Plant Drainage Pipe, and Entomology Shop* (URS 1995b)
- *Bioventing at Operable Units 5, 8, 9, 10, and 11—Removal Action Report* (BEI 1996a)
- *Operation and Maintenance Plan for Bioventing at Operable Units 5, 8, 9, 10, and 11* (BEI 1996b)
- *Excavations in OUs 5, 8, 9, 10, and 11—Removal Action Report* (BEI 1996c)
- *Bioventing at OUs 5, 8, 9, 10, and 11 Removal Action Work Plan,* Addendum #1 (BEI 1996d)
- *Bioventing Semiannual Report* (BEI 1996e)
- *Bioventing Alternatives Technical Memorandum* (BEI 1996f)

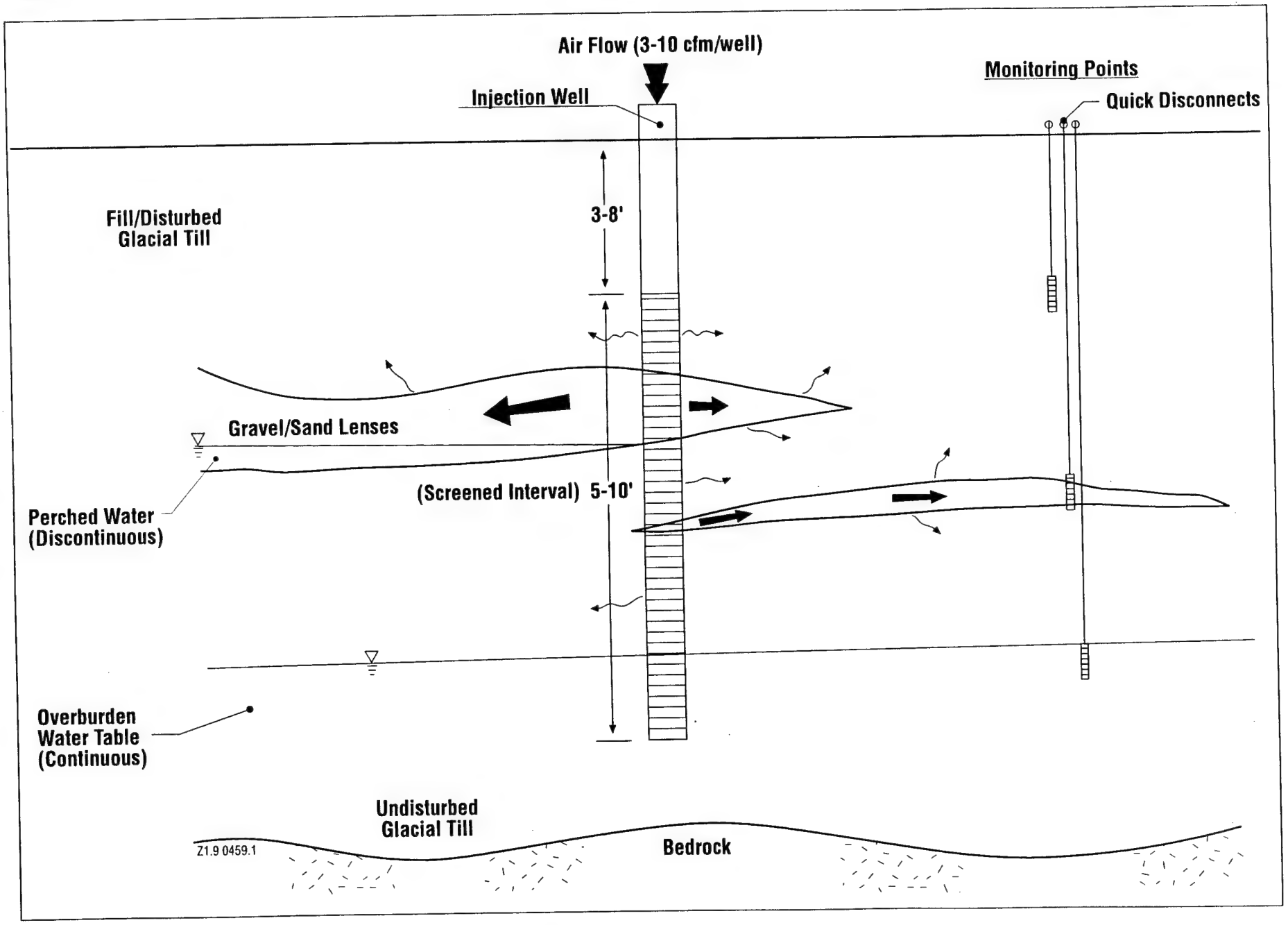


Figure 1-2 Bioventing Conceptual Model

- 1996 *Monthly Bioventing Reports* (BEI 1996g through j)
- *Bioventing Semiannual Report* (BEI 1997a)
- *Bioventing Removal Action Report, Addendum 1* (BEI 1997b)
- *Bioventing at OUs 5, 8, 9, 10, and 11 Removal Action Work Plan, Addendum 2* (BEI 1997c)
- 1997 *Monthly Bioventing Reports* (BEI 1997d through o)
- *Bioventing Semiannual Performance Report August - December 1997.* May (BEI 1998a)
- 1998 *Monthly Bioventing Reports* (BEI 1998b through g)

2.0 SYSTEM MAINTENANCE

Routine weekly, monthly, and time-driven maintenance activities performed in accordance with work plan specifications included checking lubrication levels, air dryer desiccant levels, and blower drive belts; changing blower lubricant at specified intervals; draining fluids from air dryer tanks; and adding desiccant as needed.

No major equipment problems occurred during this period. The programmable logic control (PLC) boards at FTF were found to be malfunctioning in December 1997 when the system was being changed from bioslurp mode to biovent mode for winter operation. The system was repaired and restarted in January 1998.

The systems at NDA-4 and NDA-5 were shut down from September to December 1, 1997 due to construction by Depot Roads, a COE subcontractor removing fuel lines. The piping network at NDA-1 was joined with NDA-3, and the piping at NDA-4 was joined with NDA-5 on January 19, 1998. The blowers at NDA-3 and NDA-4 were shut down and the systems run with blowers at NDA-1 and NDA-5 to save operations costs in response to recommendations made in the previous semiannual report.

Spring confirmation soil sampling recommended in the last semiannual report is scheduled to begin in July 1998, therefore this data will not be presented within this report.

3.0 SYSTEMS OPERATION

Key operational activities observed over the first 28 months are discussed in Section 3.1. Section 3.2 summarizes problems encountered and sitewide lessons learned since startup. Section 3.3 presents rainfall data.

Operational data collected during this reporting period include monthly flow measurements taken at each AIW, monthly soil gas sampling results from MPs, and in situ respiration results from the spring 1998 tests. Data downloaded from oxygen sensors are included in the data tables as monthly averages; daily readings are available in the project files.

3.1 OPERATIONS SUMMARY

3.1.1 Air Flow Rates

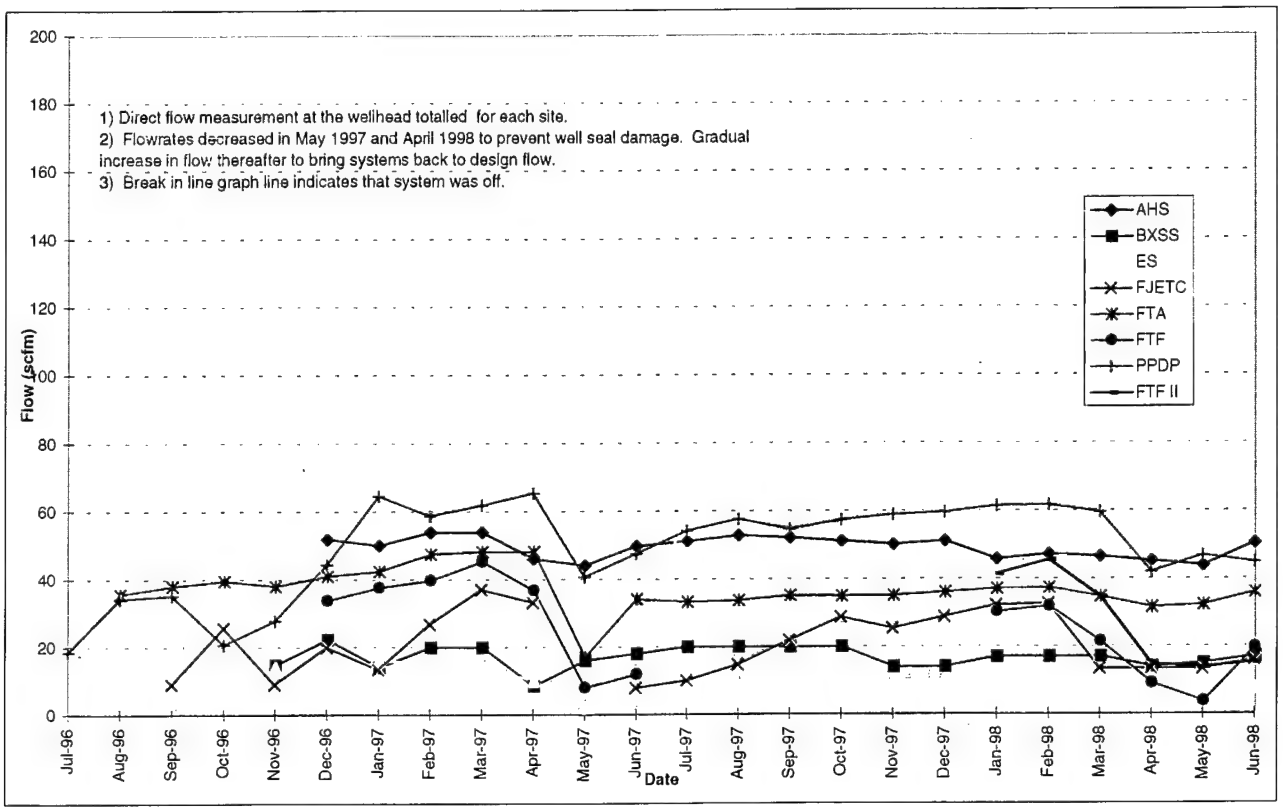
The rate of air flow to the wellheads determines the rate at which oxygen is supplied to the subsurface. The wellhead flow rate is a function of soil characteristics (e.g., permeability and saturation). Generally, soils with lower permeability result in lower flow rates at a given pressure. Since injection pressure is directly related to flow rate, an increase in pressure results in increased flow rates. If the injection pressure is too high, however, the soil may fracture and create macropathways for the air, thus negating any benefit for increased air flow. The maximum allowable injection pressure varies due to varying soil types and the depth of the AIW screen interval, but it is generally kept less than 5 psi (equivalent of approximately 8 ft of overburden pressure). Overburden pressures for each AIW were calculated at the depth of the top of the screen; a soil density of 100 lb/ft^3 was assumed. These values are provided in the site-specific data tables presented in Sections 4.0 through 19.0.

Figure 3-1 plots total monthly air flow at each site since startup. In general, there was a downturn in monthly total flow at each system between March and April 1998 related primarily to snowmelt and greater than normal precipitation. Although 1998 precipitation levels remained above normal through June, warmer temperatures and increased evapotranspiration beginning in late May through June resulted in the drying of soils and subsequent air uptake. NDAs 1, 3, 4, 7, and 8 continued to have some AIWs which are nonfunctional or are accepting flows at a rate too low to measure. Further discussion of this is included in site-specific sections presented later in this report.

3.1.2 Soil Gas Monitoring

Soil gases are sampled to quantify subsurface aeration rates. AFCEE protocol recommends maintaining an oxygen level of at least 5 percent, the level required to maintain oxygen-limited aerobic degradation (AFCEE 1992); this level is used as a reference point for operation of the biovent systems. Oxygen levels are measured either by taking soil gas samples from the MPs or by in situ oxygen meters. If oxygen levels are found to be below 5 percent at any MP, flow rates from adjacent AIWs are increased to raise oxygen concentrations at that location (see Figure 1-1).

In many instances, soil gas in the MPs cannot be sampled; the lack of soil gas can be attributed to high water table, soil saturation, low-permeability soil, screen clogging, or frozen tubing. Historically, the most successful MP sampling has occurred during the months of June through October when the water table has subsided and evapotranspiration rates have increased.



NDA System not yet installed from Jul - Nov 1996.

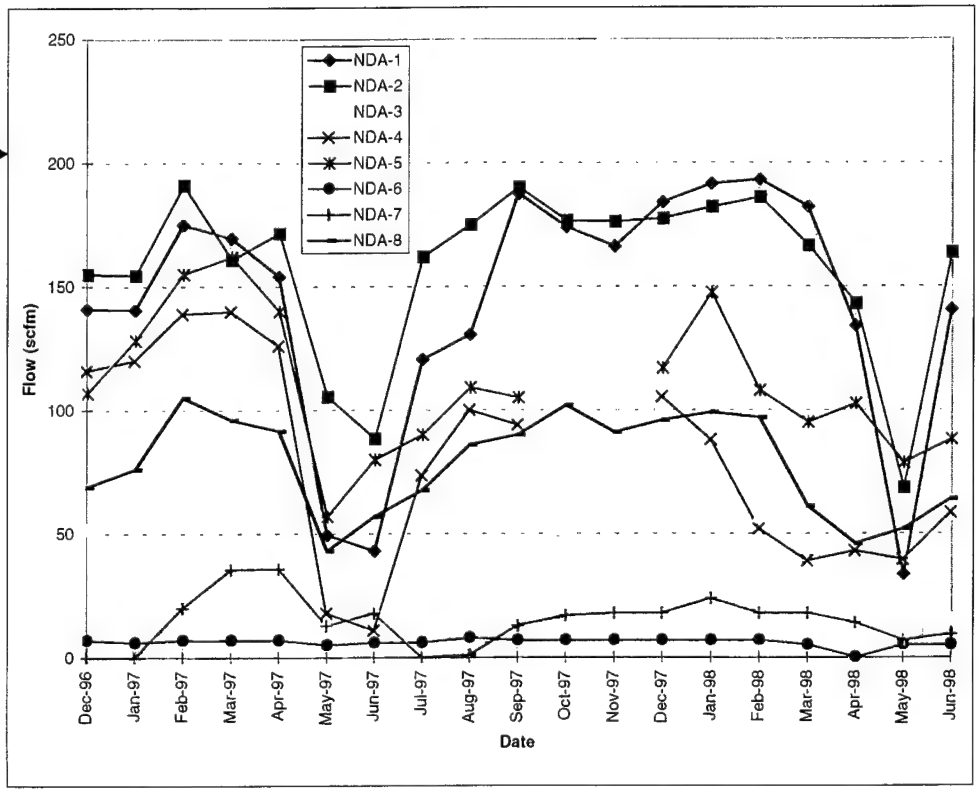


Figure 3-1 Monthly Air Flow

3.1.3 Respiration Testing

In situ respiration tests are performed semiannually, generally in the late spring or early summer and fall; the MPs freeze during the winter and water levels are high in the spring, which make it difficult to perform respiration tests from November to May. Respiration tests were performed in some of the oxygen sensors during January 1998 in response to recommendations made in the previous semiannual report. The systems were shut down and the oxygen sensors reprogrammed to collect readings every 30 minutes. Only a few oxygen sensors produced data due to the majority having high oxygen at the start, therefore resulting in no change and no rate to calculate.

The in situ respiration tests are conducted in accordance with design specifications (URS 1995b) and AFCEE protocol (AFCEE 1992). MPs that produce soil gas samples with oxygen levels close to ambient conditions are not good candidates for respiration tests. MPs selected for the respiration test are chosen only after the air injection has been turned off for a minimum of 24 hours and a soil gas sample from each MP is analyzed to determine a representative oxygen and carbon dioxide concentration (these soil gas samples are referred to as *pretest* samples). A 1 to 3 percent concentration of helium in air is injected as a tracer for 2 h; after this injection period, the air/helium source is discontinued. Soil gas samples are taken and analyzed by field instruments for oxygen, carbon dioxide, helium, and total volatile hydrocarbons (TVH). Generally the test is concluded once oxygen levels go below 5 percent or 72 hours have passed.

Oxygen utilization rates are then calculated based on the initial linear portion of the curve, typically the first 8 to 12 hours. Biovent system operations will continue until a site's oxygen utilization rate matches background levels. At Loring AFB, the background oxygen utilization rate was found to be 0.1 percent/hour (2.4 percent/day) or less. Table 3-1 summarizes all in situ respiration tests run in 1996, 1997, and 1998. Biodegradation rates calculated for the winter and spring 1998 respiration results are included in Table 3-1.

3.2 LESSONS LEARNED SUMMARY

System performance has improved over the past year because of increased system operation knowledge. Challenges encountered over the past 2 years have included well seal leaks, inaccurate flow measurements, inundation of AIWs, lack of soil gas samples, and adverse weather conditions. These items are discussed in more detail in the first and second semiannual reports (BEI 1996e and 1997a).

3.2.1 Well Seal Leaks

Well seal leaks were eliminated either by limiting the injection pressure to 5 psi or less or by removing the AIW from use. This was successful, and no previously installed seals were compromised in the past 12 months. As the winter progressed, injection pressures were monitored carefully to maintain sealed wells, especially during spring thaw. When the well seals were fully hydrated, pressure was increased but kept at 5 psi or less.

Results from the 1996,1997, and 1998 Respiration Testing

Site	Monitoring Point	Summer 1996 Oxygen Utilization Rate (% / hour)	Fall 1996 Oxygen Utilization Rate (% / hour)	Spring 1997 Corrected Oxygen[1] Utilization Rate (% / hour)	Fall 1997 Corrected Oxygen[1] Utilization Rate (% / hour)	Spring 1998 Oxygen Utilization Rate (% / hour)	Spring 1998 Corrected Oxygen[1] Utilization Rate (%/hour)	Spring 1998 Biodegradation Rate[2] (mg TPH/kg soil/day)
AHS	MP-1-5	Not installed	7.5	1	0.75	water	na	na
	MP-2-13	Not installed	0.26	0.003	0.04	no flow	na	na
	MP-4-3	Not installed	nt	nt	0.15	0.20	0.19	3.3
	MP-4-13	Not installed	0.04	0.05	0.05	0.08	0.08	1.4
	MP-5BG-4	Not installed	nt	0.98	na	0.95	0.95	16.3
	MP-6-4	Not installed	nt	nt	nt	0.21	helium not used[3]	3.6
	MP-6-5	Not installed	nt	nt	nt	0.02	helium not used[3]	0.3
	MP-8-15	Not installed	nt	nt	nt	0.14	helium not used[3]	2.4
	MP-9-6.5	Not installed	nt	nt	nt	0.08	0.08	1.4
	average =		2.6	0.51	0.25	0.24	0.33	4.1
BXSS	VM-1-5	0.41	0.71	0.48	0.46	0.38	0.40	6.8
	VM-2-5	0.71	0.11	0.49	nt	0.46	0.48	na
	MP-1-3.5	nt	nt	nt	nt	0.31	0.30	5.1
	MP-1-7.5	0.32	0.4	0.08	0.12	water	na	na
	MP-2-8.5	1.3	1.1	0.11	0.25	0.13	0.14	2.4
	MP-3-3.5	nt	nt	nt	nt	0.11	0.08	1.4
	MP-4BG-8	nt	1.3	Water/nt	na	0.07	0.07	na
	average =	0.69	0.72	0.29	0.28	0.24	0.25	3.9
ES	MP-2-3	Not installed	0.01	No flow/nt	na	High oxygen	na	na
	MP-2-14	Not installed	0.01	High oxygen/nt	0.00	High oxygen	na	na
	MP-5-9.5	Not installed	Not installed	Not installed	0.01	High oxygen	na	na
	average =				0.01			
FJETC	MP-6-3	nt	nt	nt	nt	0.12	0.10	1.7
	MP-7-3	nt	0.66	0.31	0.70	0.87	0.85	14.5
	average =					0.50	0.48	8.1
FTA	MP-1-6	nt	nt	0.22	na	0.18	0.19	3.3
	MP-2-3	nt	nt	nt	nt	0.95	0.88	15.1
	MP-3-6	nt	nt	nt	nt	0.31	0.21	3.6
	MP-4BG	nt	nt	nt	nt	0.21	0.30	5.1
	MP-5-3	nt	nt	nt	nt	0.31	0.30	5.1
	MP-9-3	nt	2.4	0.60	0.43	1.60	1.54	26.4
	MP-9-10	nt	nt	nt	nt	0.14	0.10	1.7
	MP-10-3	nt	0.89	0.32	na	0.42	0.39	6.7
	MP-11-3	nt	1.45	0.39	0.19	0.43	0.42	7.2
	MP-12-6	0.17	0.23	0.18	0.03	0.09	0.09	1.5
	MP-13-6	nt	nt	nt	nt	0.10	0.10	1.7
	MP-14-8.5	0.31	0.26	0.19	0.14	0.21	0.23	3.9
	MP-15-10	nt	nt	nt	nt	0.17	0.13	2.2
	average =	0.24	1.05	0.32	0.20	0.39	0.40	6.8
FTF	MP-2-15	Not installed	0.77	No flow	na	Destroyed	na	na
	MP-3-10	Not installed	0.4	Water	na	Destroyed	na	na
	MP-7-2.5	nt	nt	nt	nt	3.2	3.03	51.9
	average =		0.59					
FTF II	MP-3-5.5	Not installed	Not installed	Not installed	2.81	water	na	na
	MP-9-6	nt	nt	nt	nt	0.01	helium not used[3]	0.2
	MP-13-5.5	Not installed	Not installed	Not installed	1.41	water	na	na
	average =				2.11			

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Table 3 - continued

NDA-1	MP-1-3-5.5	Not installed	NT	0.12	na	High oxygen	na	na
	MP-1-4-8	Not installed	4.2	Water	na	Water	na	na
	MP-1-6-5	Not installed	4.0	0.16	0.34	0.12	0.11	1.9
	MP-1-6-8	Not installed	5.1	Water	0.76	0.46	0.45	7.7
	average =		4.65	0.14	0.55	0.29	0.28	4.8
NDA-2	MP-2-2-5	Not installed	0.07	High oxygen	na	High oxygen	na	na
	MP-2-2-8	Not installed	0.07	High oxygen	na	High oxygen	na	na
NDA-3	No points available for respiration testing due to 'No flow' or Water							
NDA-4	MP-4-2BG	nt	nt	nt	0.05	Water	na	na
	MP-4-4	nt	nt	nt	0.77	Water	na	na
	average =				0.41	na	na	na
NDA -5	MP-5-1-9.5	Not installed	7.2	Water/nt	na	Water	na	na
	MP-5-4-7.5	Not installed	0.05	High oxygen/nt	na	High oxygen	na	na
	average =		3.63					
NDA-6	MP-6-2BG-7	Not installed	nt	0.04	0.06	0.14	0.10	1.7
	MP-6-3-8.5	Not installed	0.014	Water/nt	na	Water	na	na
NDA-7	No points available for respiration testing due to 'No flow' or Water							
NDA -8	No points available for respiration testing due to 'No flow'/Water/High oxygen							
PPDP	MP-1-3	nt	nt	nt	nt	1.19	1.16	19.9
	MP-2-3	0.65	nt	No flow/nt	na	0.26	0.27	4.6
	MP-2-6	nt	nt	nt	nt	0.10	0.08	1.4
	MP-3-3	1.7	1.2	0.98	na	1.45	1.43	24.5
	MP-3-6	0.73	0.46	0.45	0.65	0.32	0.31	5.3
	MP-4-3	0.45	0.15	0.17	0.22	0.25	0.26	4.5
	MP-5-3	nt	nt	nt	nt	0.52	0.53	9.1
	MP-6-3	0.56	0.19	0.11	0.09	0.19	0.19	3.3
	MP-8-3					0.10	0.05	0.9
	MP-9-8.5	Not installed	Not installed	Not installed	0.40	0.27	0.24	4.1
	average =	0.82	0.50	0.24	0.34		0.45	7.7

na = not applicable
nt = not tested

[1] Oxygen utilization rate corrected as follows:

a) Determine helium loss per hour (all helium data was used to determine slope);
b) Correct helium decay by dividing helium loss per hour by 2.8 (difference in diffusion rate of helium and oxygen);
c) subtract corrected helium decay from initial oxygen utilization rate.

[2] Hydrocarbon biodegradation rate = (K_d)

$$K_d = \frac{K_o \times A \times R \times D_o}{100} \times 24$$

K_d = degradation rate (mg TPH/kg soil/day)
K_o = corrected oxygen utilization rate (%/hour)
A = Air filled porosity per kg of soil, calculated (0.192)
R = Ratio of TPH mineralization to oxygen required (1:3.5 for hexane)
D_O = Density of oxygen at 68° F (1,300 mg/L)
[Equation and values from URS 1995b (Section 02020)]

[3] Test performed on oxygen sensor in January 1998. Test was performed by recording oxygen levels after system shutdown. Helium could not be used.

3.2.2 Flow Rates

Initial flow measurements were unreliable because of the measurement method being used. A flow meter demonstration performed during the summer of 1996 to evaluate different flow measuring devices (BEI 1996e) indicated that a Dwyer® in-line rotometer provided the most accurate flow readings. All AIWs were retrofitted with these instruments and are working well under all conditions.

3.2.3 Inundation of AIWs

During the spring and summer, inundation of the AIWs is a major inhibitor of air injection. This problem is anticipated to continue because groundwater levels fluctuate seasonally. However, if constant pressure at a high enough level to overcome the hydrostatic head above the top of screen is applied to an AIW, air will eventually make its way into the subsurface. This scenario is relevant only if a minority of the total number of wells are inundated. During periods of rising groundwater levels, attention will be paid to injection pressures and flow rates. If water levels completely inundate most of the site's AIWs, the system will be turned off until groundwater levels subside because only a small volume of soil designed per treatment is being treated.

3.2.4 Soil Gas Monitoring

For several reasons, soil gas samples have generally been difficult to collect—well point screened in tight soil, MP inundation, clogged screen, compromised tubing, or frozen tubing—and no better collection method has been found. As recommended in the first half-1997 semiannual report, new MPs were added to several sites on July 25–29, 1997; mid-month monitoring of these new MPs began in August 1997. Depth to water within the MPs will be determined when practical. Following the summer 1998 confirmation soil sampling and evaluation, recommendations to install new MPs where improvement in the operation of current MPs is not believed possible or an alternative remedial action (i.e., excavation with ex situ treatment) will be made.

Soil gas samples collected in May 1997 from AHS, BXSS, ES, FJETC, and FTA were considered suspect because of consistently high oxygen and low carbon dioxide levels. Air samples were collected in May from several locations that did not yield samples before or after the month of May.

In addition, high oxygen levels were noted at locations with historically low levels (i.e., FJETC-MP7-3 and FTA-MP9-3). Both of these anomalies suggest leaks in the sampling equipment; for example, the lid to the jar on the air sampling device may have been leaking, thus diluting the soil gas sample with ambient air. The entire sampling system has been checked for leaks, and new tubing has been installed. All soil gas monitoring data will be compared with historic data as an additional verification step.

3.2.5 General

Biovent systems running during the winter are expected to run similarly to previous winters and, therefore, will be run at reduced air flow rates for select sites. As spring thaw begins, attention will be focused on water levels and the pressures required to maintain air injection. Oxygen sensors will be monitored during the winter, and winter respiration tests at select oxygen sensor locations will be conducted, weather permitting. MPs will not be sampled until spring thaw.

Respiration tests scheduled for fall 1998 will include all MPs tested in the past and additional sites where respiration tests have not yet been performed—the exception being any biovent systems shut down due to the confirmation sampling results. MPs will be selected on the basis of soil gas sample collectibility.

The site-specific sections that follow provide evaluations and recommendations. Table 3-2 summarizes the recommendations in the subsequent sections.

3.3 RAINFALL DATA

Table 3-3 tabulates rainfall data recorded at the weather station in Caribou, Maine, over the past 6 months, and Figure 3-2 illustrates monthly totals and cumulative values for the past 2 and a half years. The graph clearly shows that cumulative precipitation during January through October 1996, January through December 1997, and January through June 1998 has exceeded historical normal levels. Combined with snowmelt, these high levels may have had an impact on several of the biovent systems as noted in previous semiannual reports. Saturated soils have caused air injection rates to be lower than design flow, and several MPs were affected by saturation levels, resulting in reduction of monitoring data.

Table 3-2
Summary of Site-Specific Recommendations

Site	Recommendation
AHS	Functioning well, biodegradation rates are decreasing. Install two new AIWs near northwest side of background MP-5BG.
BXSS	Continue bioventing until an evaluation of soil samples collected in the summer of 1998 is completed.
ES	Continue bioventing until an evaluation of soil samples collected in the summer of 1998 is completed.
FJETC	Continue bioventing until an evaluation of soil samples collected in the summer of 1998 is completed.
FTA	Continue bioventing until an evaluation of soil samples collected in the summer of 1998 is completed.
FTF	Begin bioslurp mode as soon as groundwater fluctuations and levels decrease/subside.
FTF II	No changes recommended.
NDAs	Continue bioventing until an evaluation of soil samples collected in the summer of 1998 is completed.
PPDP	No changes recommended. Evaluate soil samples collected during the summer of 1998.
General	Perform respiration tests in both MPs and oxygen sensors in the fall of 1998 without helium as a tracer. Historical results show that dispersion of injected air has negligible effect on determining biodegradation rates.

Table 3-3 Precipitation Data Caribou, Maine (1/98 - 6/98)

January Precipitation (in.)		February Precipitation (in.)		March Precipitation (in.)		April Precipitation (in.)		May Precipitation (in.)		June Precipitation (in.)	
1-Jan-98	0	1-Feb-98	0	1-Mar-98	0.35	1-Apr-98	0.13	1-May-98	0	1-Jun-98	0.06
2-Jan-98	0.01	2-Feb-98	0	2-Mar-98	0.03	2-Apr-98	0.26	2-May-98	0.25	2-Jun-98	0
3-Jan-98	0	3-Feb-98	0	3-Mar-98	0	3-Apr-98	0.43	3-May-98	0.14	3-Jun-98	0.41
4-Jan-98	0.01	4-Feb-98	0	4-Mar-98	0.01	4-Apr-98	0	4-May-98	0.04	4-Jun-98	0.09
5-Jan-98	0.15	5-Feb-98	0	5-Mar-98	0	5-Apr-98	0	5-May-98	0.06	5-Jun-98	0.19
6-Jan-98	0.5	6-Feb-98	0	6-Mar-98	0	6-Apr-98	0	6-May-98	0.05	6-Jun-98	0.04
7-Jan-98	0.15	7-Feb-98	0	7-Mar-98	0.05	7-Apr-98	0.02	7-May-98	0.35	7-Jun-98	0
8-Jan-98	0.95	8-Feb-98	0	8-Mar-98	0.05	8-Apr-98	0	8-May-98	0.28	8-Jun-98	0
9-Jan-98	0.55	9-Feb-98	0	9-Mar-98	1.18	9-Apr-98	0	9-May-98	0.38	9-Jun-98	0
10-Jan-98	0.09	10-Feb-98	0	10-Mar-98	0.18	10-Apr-98	0	10-May-98	0	10-Jun-98	0
11-Jan-98	0	11-Feb-98	0	11-Mar-98	0.01	11-Apr-98	0	11-May-98	0	11-Jun-98	0
12-Jan-98	0	12-Feb-98	0.34	12-Mar-98	0	12-Apr-98	0	12-May-98	0	12-Jun-98	0
13-Jan-98	0.24	13-Feb-98	0	13-Mar-98	0	13-Apr-98	0	13-May-98	0	13-Jun-98	0.02
14-Jan-98	0.01	14-Feb-98	0	14-Mar-98	0.04	14-Apr-98	0	14-May-98	0	14-Jun-98	0
15-Jan-98	0	15-Feb-98	0	15-Mar-98	0.07	15-Apr-98	0	15-May-98	0	15-Jun-98	0.74
16-Jan-98	0	16-Feb-98	0	16-Mar-98	0	16-Apr-98	0.01	16-May-98	0	16-Jun-98	0.2
17-Jan-98	0	17-Feb-98	0	17-Mar-98	0	17-Apr-98	0.46	17-May-98	0	17-Jun-98	0.01
18-Jan-98	0	18-Feb-98	0	18-Mar-98	0	18-Apr-98	0	18-May-98	0	18-Jun-98	0.04
19-Jan-98	0.02	19-Feb-98	0.91	19-Mar-98	0	19-Apr-98	0	19-May-98	0.01	19-Jun-98	0
20-Jan-98	0.04	20-Feb-98	0.21	20-Mar-98	0.16	20-Apr-98	0.48	20-May-98	0	20-Jun-98	0.04
21-Jan-98	0	21-Feb-98	0.05	21-Mar-98	0	21-Apr-98	0	21-May-98	0.63	21-Jun-98	0
22-Jan-98	0	22-Feb-98	0	22-Mar-98	0.39	22-Apr-98	0	22-May-98	0.47	22-Jun-98	0
23-Jan-98	0.09	23-Feb-98	0	23-Mar-98	0	23-Apr-98	0	23-May-98	0.42	23-Jun-98	0
24-Jan-98	0.97	24-Feb-98	0.01	24-Mar-98	0	24-Apr-98	0.34	24-May-98	0.06	24-Jun-98	0
25-Jan-98	0.09	25-Feb-98	0.92	25-Mar-98	0	25-Apr-98	0.06	25-May-98	0.09	25-Jun-98	0
26-Jan-98	0	26-Feb-98	0.17	26-Mar-98	0.34	26-Apr-98	0	26-May-98	0.2	26-Jun-98	0.1
27-Jan-98	0	27-Feb-98	0.01	27-Mar-98	0.22	27-Apr-98	0.04	27-May-98	0	27-Jun-98	0
28-Jan-98	0	28-Feb-98	0	28-Mar-98	0.01	28-Apr-98	0	28-May-98	0	28-Jun-98	0
29-Jan-98	0.03			29-Mar-98	0	29-Apr-98	0	29-May-98	0.03	29-Jun-98	0.01
30-Jan-98	0.17			30-Mar-98	0.06	30-Apr-98	0	30-May-98	0	30-Jun-98	1.27
31-Jan-98	0			31-Mar-98	0.36			31-May-98	0.15		
Total:	4.07		2.62		3.51		2.23		3.61		3.22

Source: National Oceanic Atmospheric Administration, National Weather Service, Caribou, Maine

Note: Reported "trace" amounts of rain were listed as zero precipitation.

Month	Monthly Rainfall (inches)					Cumulative Rainfall (inches)				
	Normal[1]	1995	1996	1997	1998	Normal	1995	1996	1997	1998
Jan	2.42	5.60	4.05	3.60	4.07	2.42	5.60	4.05	3.60	4.07
Feb	1.92	2.70	2.69	2.52	2.62	4.34	8.30	6.74	6.12	6.69
Mar	2.43	2.23	1.74	2.47	3.51	6.77	10.53	8.48	8.59	10.20
Apr	2.45	2.12	3.59	1.68	2.23	9.22	12.65	12.07	10.27	12.43
May	3.07	2.46	3.52	5.02	3.61	12.29	15.11	15.59	15.29	16.04
Jun	2.91	1.18	3.42	4.37	3.22	15.20	16.29	19.01	19.66	19.26
Jul	4.01	1.48	6.32	2.64		19.21	17.77	25.33	22.30	
Aug	4.07	2.94	2.66	4.12		23.28	20.71	27.99	26.42	
Sep	3.45	1.90	3.81	2.67		26.73	22.61	31.80	29.09	
Oct	3.10	5.13	3.41	1.31		29.83	27.74	35.21	30.40	
Nov	3.55	4.88	1.49	2.08		33.38	32.62	36.70	32.48	
Dec	3.22	1.79	3.72	2.81		36.60	34.41	40.42	35.29	

[1] Normal represents historical average for the month.

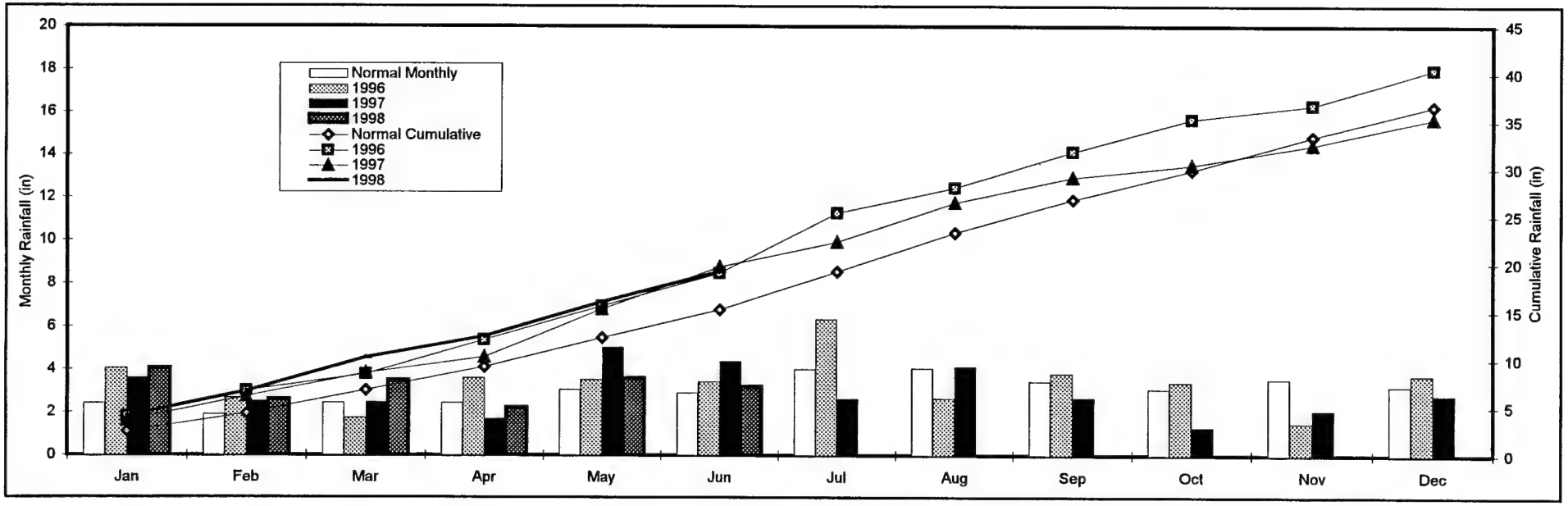


Figure 3-2 Monthly and Cumulative Rainfall Amounts

4.0 AUTO HOBBY SHOP

4.1 OPERATIONS

Figure 4-1 presents the average flow at each AIW. In general, the AIWs located at the AHS operated per design throughout the first half of 1998 (Table 4-1).

4.2 CONCLUSIONS AND RECOMMENDATIONS

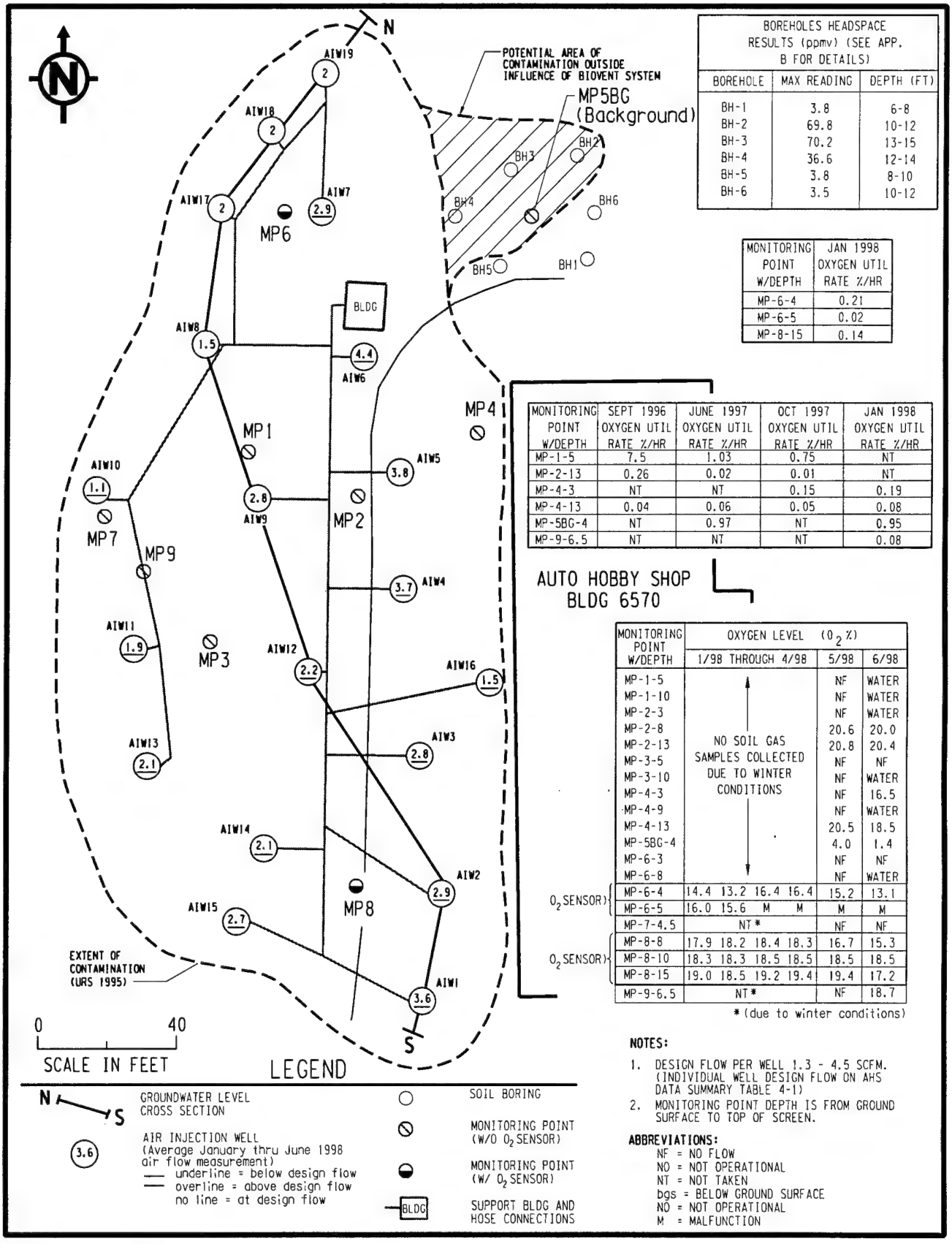
Soil gas samples were not collected at MPs from January through April at all biovent sites due to winter conditions. Table 4-2 presents the monthly AIW groundwater data, including a graph showing the February, April, and June groundwater levels in the AIWs located along the north-south section identified on Figure 4-1. It is evident that groundwater saturation at the AHS was not a problem; only AIW-1 and AIW-2 had groundwater levels approaching the top of the screen. Figure 4-2 presents monthly groundwater levels and air injection rates along the north-south transect for 1998. Monthly and normal rainfall totals have been added for correlation with the water and air data. All AIWs accepted air except AIW-2 (May airflow = zero), which is located near the south end of the AHS.

Data presented in Table 4-1 indicate that active respiration is occurring at MPs 5 and 6. Background location MP 5 continues to exhibit the greatest volatile readings (422 ppmv) and the lowest oxygen readings (1.4 percent).

Respiration tests performed on June 23, 1998 included four MPs, one of which was a new location not previously tested. Three winter respiration tests were performed using the oxygen sensors in MPs 6-4, 6-5, and 8-15. Winter respiration tests were performed in January simply by turning off the biovent system and collecting readings from the oxygen sensor every hour. Respiration data and results for the respiration tests are shown on Figures A-1 through A-4 (Appendix A). MP 1-5 and 2-13 tested in 1996 and 1997 were not tested this time due to water saturation and high oxygen, respectively. MPs 4-13, 6-5, 8-15, and 9-6.5 were at background levels, indicating that biodegradation may be complete. The oxygen utilization rate at MP 5BG was 0.95 percent/hour in June, unchanged from 0.98 percent a year ago. This constant reading is an indication that the air from AIWs 7 and 6 has not affected or reached this area. The remaining respiration tests were at 0.21 percent per hour or less, a level not much greater than background.

The biovent system had operated for a total of 575 days through June 30, 1998.

Overall Recommendation for AHS: Most of the site is operating per design, and most MPs are providing data. No significant operational changes to the air flow settings or improvements to MPs are recommended for the AHS site at this time; therefore, the system should remain in operation until all areas of the site reflect background conditions. The distance to the potentially contaminated soils near MP-5BG is beyond the radius of influence of the nearest AIWs; therefore, two new AIWs are recommended to be added between boreholes BH2 and BH3 and BH3 and BH4 (Figure 4-1).



BOREHOLES HEADSPACE RESULTS (ppmv) (SEE APP. B FOR DETAILS)		
BOREHOLE	MAX READING	DEPTH (FT)
BH-1	3.8	6-8
BH-2	69.8	10-12
BH-3	70.2	13-15
BH-4	36.6	12-14
BH-5	3.8	8-10
BH-6	3.5	10-12

MONITORING POINT W/DEPTH	JAN 1998 OXYGEN UTIL RATE %/HR
MP-6-4	0.21
MP-6-5	0.02
MP-8-15	0.14

MONITORING POINT W/DEPTH	SEPT 1996 OXYGEN UTIL RATE %/HR	JUNE 1997 OXYGEN UTIL RATE %/HR	OCT 1997 OXYGEN UTIL RATE %/HR	JAN 1998 OXYGEN UTIL RATE %/HR
MP-1-5	7.5	1.03	0.75	NT
MP-2-13	0.26	0.02	0.01	NT
MP-4-3	NT	NT	0.15	0.19
MP-4-13	0.04	0.06	0.05	0.08
MP-5BG-4	NT	0.97	NT	0.95
MP-9-6.5	NT	NT	NT	0.08

MONITORING POINT W/DEPTH	OXYGEN LEVEL (O_2 %) 1/98 THROUGH 4/98	5/98	6/98
MP-1-5	NO SOIL GAS SAMPLES COLLECTED DUE TO WINTER CONDITIONS	NF	WATER
MP-1-10		NF	WATER
MP-2-3		NF	WATER
MP-2-8		20.6	20.0
MP-2-13		20.8	20.4
MP-3-5		NF	NF
MP-3-10		NF	WATER
MP-4-3		NF	16.5
MP-4-9		NF	WATER
MP-4-13		20.5	18.5
MP-5BG-4		4.0	1.4
MP-6-3		NF	NF
MP-6-8		NF	WATER
O_2 SENSOR MP-6-4	14.4 13.2 16.4 16.4	15.2	13.1
O_2 SENSOR MP-6-5	16.0 15.6 M M	M	M
MP-7-4.5	NT*	NF	NF
O_2 SENSOR MP-8-8	17.9 18.2 18.4 18.3	16.7	15.3
O_2 SENSOR MP-8-10	18.3 18.3 18.5 18.5	18.5	18.5
O_2 SENSOR MP-8-15	19.0 18.5 19.2 19.4	19.4	17.2
MP-9-6.5	NT*	NF	18.7

*(due to winter conditions)

NOTES:

1. DESIGN FLOW PER WELL 1.3 - 4.5 SCFM. (INDIVIDUAL WELL DESIGN FLOW ON AHS DATA SUMMARY TABLE 4-1)
2. MONITORING POINT DEPTH IS FROM GROUND SURFACE TO TOP OF SCREEN.

ABBREVIATIONS:

NF = NO FLOW
NO = NOT OPERATIONAL
NT = NOT TAKEN
bgs = BELOW GROUND SURFACE
NO = NOT OPERATIONAL
M = MALFUNCTION

22784/043/FIG3-3.DGN

Figure 4-1
AHS Biovent System Layout and Average Wellhead Flow

Table 4 - 1 AHS Air Flow and Monitoring Point Data

Air Injection Well	Screen Interval top[3]	Screen Interval bottom[3]	Overburden Pressure[1] (psi)	Design Air Flow (scfm)	Individual Well Head Flow (scfm) January 1998	February 1998	March 1998	April 1998	May 1998	June 1998	Average Jan - Jun
AIW-1	14	21	9.7	3.8	3.8	3.8	3.8	3.4	3.2	3.8	3.6
AIW-2	15	22	10.4	3.0	3	3	3	2.7	off	2.8	2.9
AIW-3	15	22	10.4	3.0	3	3	3	2.8	2.7	3	2.9
AIW-4	14	22	9.7	3.8	3.8	3.8	3.8	3.5	3.8	3.7	3.7
AIW-5	13	21	9.0	3.8	3.8	3.8	3.8	3.5	3.8	3.8	3.8
AIW-6	13	20	9.0	4.5	4.5	4.5	4.5	4.1	4	4.5	4.4
AIW-7	8	15	5.6	3.0	3	3	2.6	3	3	3	2.9
AIW-8	6	13	4.2	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
AIW-9	10	17	6.9	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
AIW-10	6	10	4.2	1.3	0	1.3	1.3	1.3	1.3	1.3	1.1
AIW-11	7	14	4.9	2.0	2	2	1.4	1.9	2	2	1.9
AIW-12	12	19	8.3	3.0	3	3	1.6	1.4	2	2.1	2.2
AIW-13	8	15	5.6	2.8	2.8	2.8	1.9	2.4	2.8	2.8	2.6
AIW-14	11	18	7.6	3.0	0	frozen	3	2.4	2	3	2.1
AIW-15	9	16	6.3	2.8	2.8	2.8	2.5	2.5	2.8	2.8	2.7
AIW-16	15	23	10.4	3.8	off	off	off	off	off	1.5	1.5
AIW-17	5	10	3.5	2.0	2	2	2	2	2	2	2.0
AIW-18	6	11	4.2	2.0	2	2	2	2	2	2	2.0
AIW-19	7	12	4.9	2.0	2	2	2	2	2	2	2.0
Total air flow:				53.9	45.8	47.1	46.5	45.2	43.7	50.4	
Pressure (psi):					3.4	2.1	2.1	1.8	2	2.3	

Monitoring Point	Screen Interval (ft bgs) top	bottom	Notes	Soil Gas Sampling Results: January 1998 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	February 1998 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	March 1998 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	April 1998 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	May 1998 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	June 1998 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)
MP-1-5	5	5.5		No Soil Gas Samples Collected due to Winter Conditions													no flow			water	
MP-1-10	10	10.5															no flow			water	
MP-2-3	3	3.5															no flow			water	
MP-2-8	8	8.5														20.6	0.3	19	20.0	0.3	0.7
MP-2-13	13	13.5														20.8	0.0	14	20.4	0.0	1.7
MP-3-5	5	5.5															no flow			no flow	
MP-3-10	10	10.5															no flow			water	
MP-4-3	3	3.5	O_2 Util. Rate = 0.19%/hr[4]														no flow		16.5	2.2	261
MP-4-9	9	9.5															no flow			water	
MP-4-13	13	13.5	O_2 Util. Rate = 0.08%/hr[4]													20.5	0.5	6.5	18.5	1.3	5.9
MP-5BG-4	4	9	O_2 Util. Rate = 0.95%/hr[4]													4.0	16.8	422	1.4	20.0	8
MP-6-3	3	3.5															no flow			no flow	
MP-6-8	8	8.5															no flow			water	
MP-6-4	4	4.5	O_2 Util. Rate = 0.21%/hr[5]	14.4	na	na	13.2	na	na	16.4	na	na	16.4	na	na	15.2	na	na	13.1	na	na
MP-6-5	5	5.5	O_2 Util. Rate = 0.02%/hr[5]	16.0	na	na	15.6	na	na	malf	na	na	malf	na	na	malf	na	na	malf	na	na
MP 7-4.5	4.5	5															no flow			no flow	
MP-8-4	4	4.5	O_2 Sensor	17.9	na	na	18.2	na	na	18.4	na	na	18.3	na	na	16.7	na	na	15.3	na	na
MP-8-10	10	10.5	O_2 Sensor	18.3	na	na	18.3	na	na	18.5	na	na	18.5	na	na	18.5	na	na	18.5	na	na
MP-8-15	15	15.5	O_2 Util. Rate = 0.14%/hr[5]	19.0	na	na	18.5	na	na	19.2	na	na	19.4	na	na	19.4	na	na	17.2	na	na
MP-9-6.5	6.5	7	O_2 Util. Rate = 0.08%/hr[4]														no flow		18.7	0.8	0.8

[1] Maximum pressure before potential for fracturing of soil. Conservative value calculated at top of screen assuming density of soil is 100 lbs/ft^3.
[2] The monthly O_2 sensor results is the average for month.
[3] Measured from top of casing.
[4] Test performed on 6/23/98.
[5] Test performed on this oxygen sensor in January 1998 (see Table 3-1 footnote 3).
bgs = below ground surface, nr = no reading, na = not applicable, no = not operational, malf = malfunction.

NOTE: AIW's that are noted to be "off" have been shutdown due to well seal leaks.

Table 4-2 AHS Groundwater Level Data

Auto Hobby Shop Groundwater Levels from January through June 1998

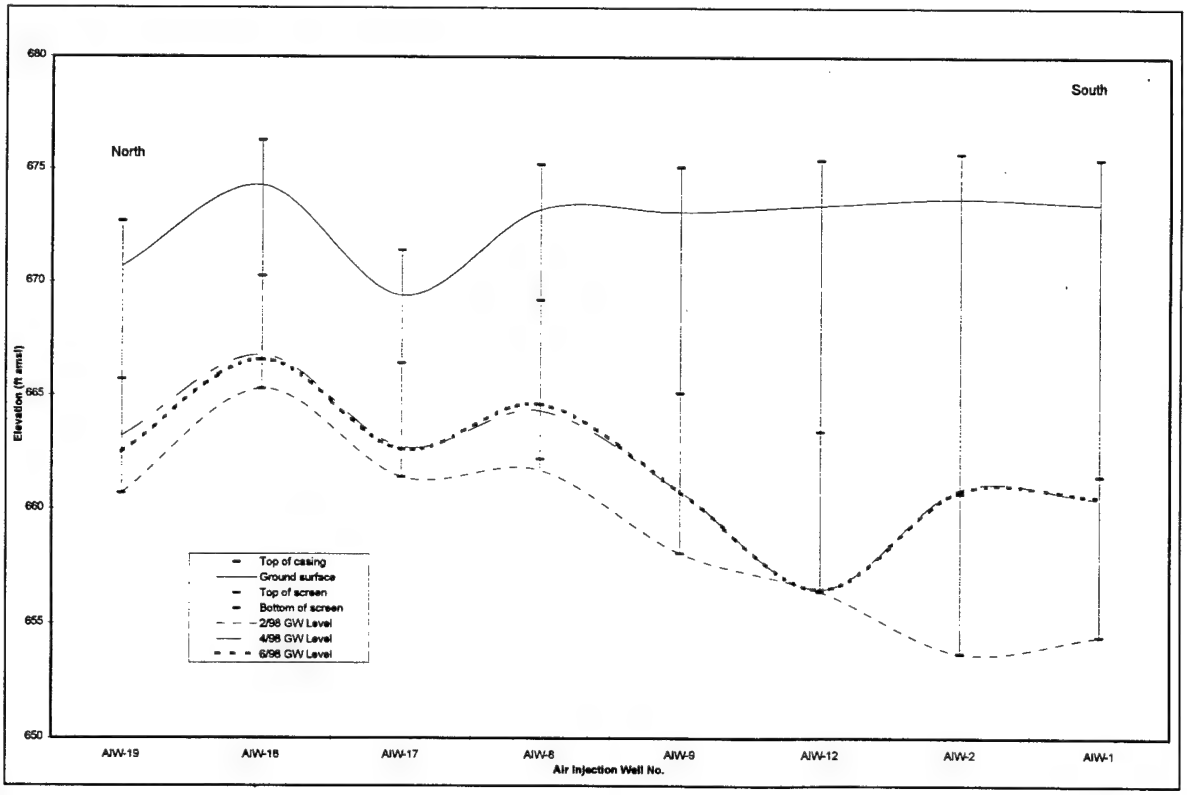
Well No.	Well Depth below TOC	Top of Screen below TOC	Jan-98	Feb-98	Mar-98	Apr-98	May-98	Jun-98
AIW-1	21	14	21	21	16.2	15	14.3	14.9
AIW-2	22	15	22	22	16.3	14.8	13.7	14.9
AIW-3	22	15	22	22	16.8	15.6	15.3	16.1
AIW-4	22	14	22	22	16	14.7	13.4	14.3
AIW-5	21	13	21	21	21	21	13.9	14.3
AIW-6	20	13	19.5	20	17.7	16.4	15.7	16.3
AIW-7	15	8	15	15	14.7	13.7	12.3	13.2
AIW-8	13.5	6	13.5	13.5	13.1	10.9	9.9	10.6
AIW-9	17	10	17	17	15.5	14.3	13.8	14.3
AIW-10	10	6	10	10	10.4	10	10	10
AIW-11	14	7	14	14	14.3	14	13.4	14
AIW-12	19	12	19	19	19.1	18.9	17.6	18.9
AIW-13	15	8	15	15	14.9	18	12.9	13.6
AIW-14	18	11	18	18	17.5	17.3	17.2	17.6
AIW-15	16	9	16	16	15.5	15.7	15.2	11
AIW-16	23	15	23	23	12.9	13.8	13.5	14.6
AIW-17	10	5	10	10	9.1	8.7	8.4	8.8
AIW-18	11	6	11	11	8.9	9.5	9.4	9.7
AIW-19	12	7	12	12	9.1	9.5	10	10.2

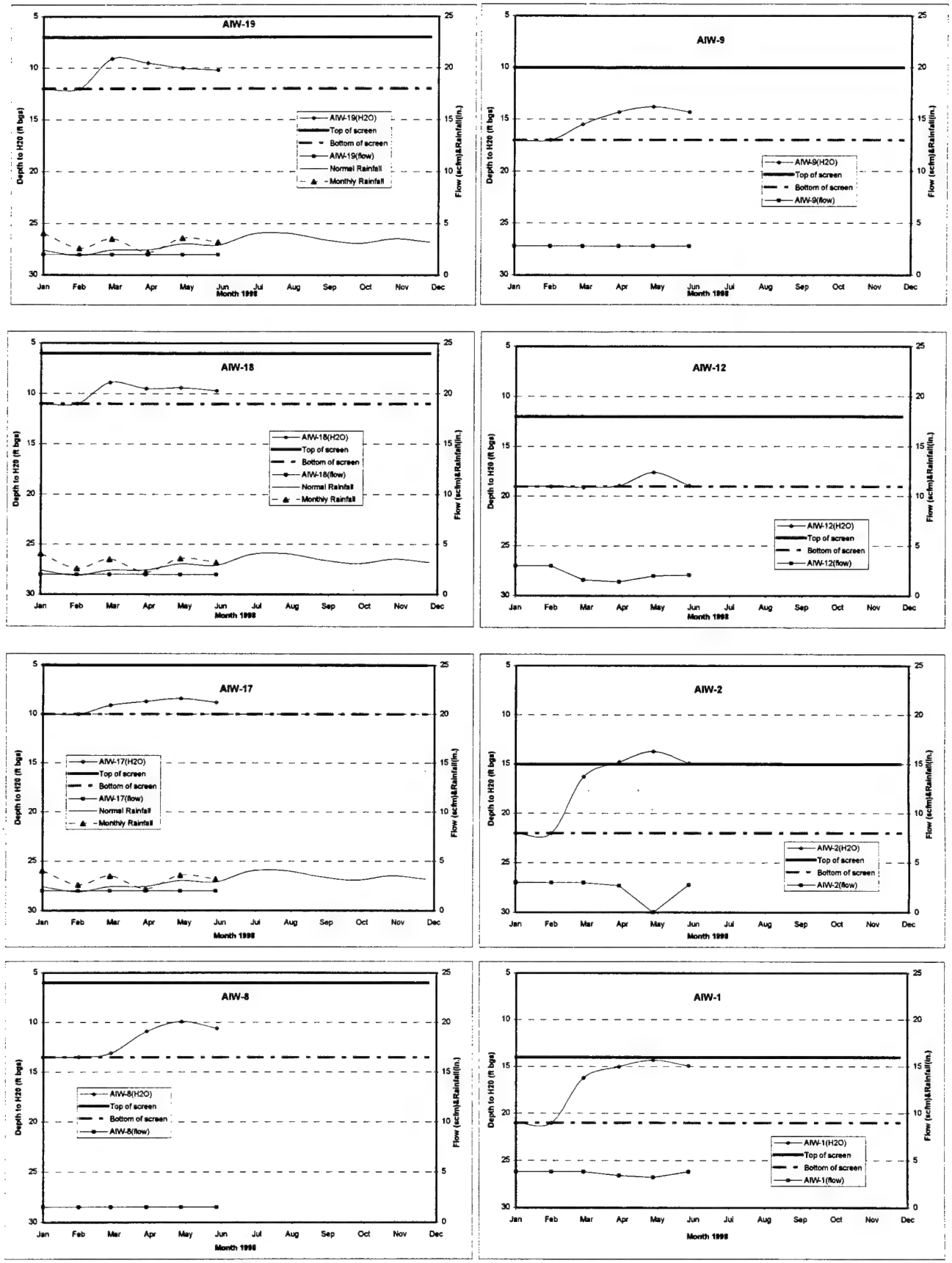
Bolded value indicates groundwater depth is at or above the top of screen.

Groundwater Levels along North / South Transect at Auto Hobby Shop (see Figure 4-1 for transect)

Well No.	Elevation at top of casing (ft amsl)	Approx elev. of ground (2 ft < TOC)	Elevation of water - FEB. (ft amsl)	Elevation of water - APR. (ft amsl)	Elevation of water - JUN. (ft amsl)	Depth to top of screen (ft)	Elevation of TOS (ft amsl)	Depth to bottom of screen (ft)	Elevation of BOS (ft amsl)
AIW-19	672.69	670.69	660.69	663.19	662.49	7	665.69	12	660.69
AIW-18	676.27	674.27	665.27	666.77	666.57	6	670.27	11	665.27
AIW-17	671.41	669.41	661.41	662.71	662.61	5	666.41	10	661.41
AIW-8	675.20	673.20	661.70	664.30	664.60	6	669.20	13	662.20
AIW-9	675.09	673.09	658.09	660.79	660.79	10	665.09	17	658.09
AIW-12	675.41	673.41	656.41	656.51	656.51	12	663.41	19	656.41
AIW-2	675.70	673.70	653.70	660.90	660.80	15	660.70	22	653.70
AIW-1	675.45	673.45	654.45	660.45	660.55	14	661.45	21	654.45

North / South Cross Section at Auto Hobby Shop





See Figure 4-1 for transect location.

Figure 4-2 AHS Groundwater/Air Flow Relations Along North/South Section

5.0 BASE EXCHANGE SERVICE STATION

5.1 OPERATIONS

The BXSS, located in OU 5, consists of 7 AIWs and 12 MPs (Figure 5-1). The biovent system pilot test originally installed in the fall of 1993 (Earth Tech 1995) consisted of three AIWs (designated as biovent points, or BVs) and six MPs (designated as vapor monitoring points, or VMs). During the summer/fall of 1996, four additional AIWs and six MPs were installed to complete the system; the newly expanded system was started up in October 1996. BEI assumed O&M responsibilities in February 1995, and the BXSS system had operated 833 days through June 30, 1998.

Table 5-1 provides individual AIW air flow data for the BXSS bioventing system. Soil gas samples were not collected from January through April due to winter conditions. Most MPs produced soil-gas samples in May and June. The lower screened interval (8 to 8.5 ft bgs) in the VMs did not produce air samples in May, but 2 out of the 3 VMs (VM-1 and VM-3) produced soil-gas in June. Over the last year, VM-2 has only allowed soil-gas samples to be collected during November 1997.

5.2 CONCLUSIONS AND RECOMMENDATIONS

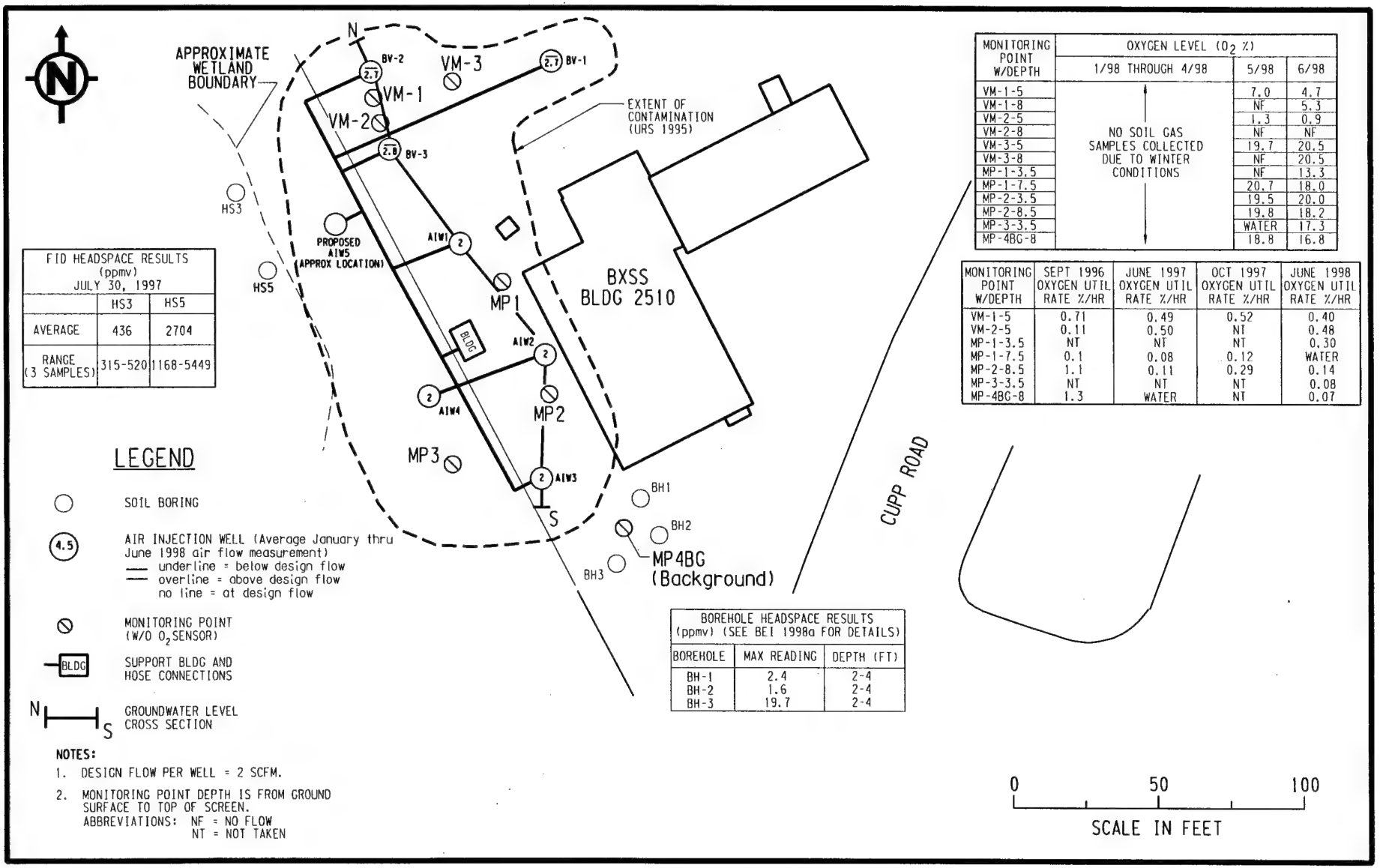
Water levels in the AIWs and BVs in April through June were elevated but only partially inundating through the reporting period (Table 5-2 and Figure 5-2), the exception being water levels near the top of the BV-2 screen from March through May. The water levels had no effect on the air injection rates on any BV or AIW (Table 5-1).

Respiration tests performed at six monitoring stations (Figures A-5 through A-8) showed that oxygen utilization rates ranged from 0.07 to 0.48 percent/hour. Oxygen utilization rates noted at three stations previously tested (VM-1-5, VM-2-5, and MP-2-8.5) were relatively unchanged. The most significant change has occurred in the background MP. The last respiration test conducted here in the fall of 1996 was 1.3 percent/hour which was significantly higher than the 0.07 percent/hour noted in June (Figure A-7). This drop along with oxygen levels of 18.8 and 16.8 percent during May and June, respectively, suggests sufficient biodegradation may have occurred in this area. The background MP is on the outer fringe of the radius of influence from AIW-3.

In general, oxygen levels have increased in most MPs since samples were first taken in September 1996. VM-1-5 and VM-2-5 continue to indicate that enhanced biodegradation is occurring (i.e., low oxygen levels and high oxygen utilization rates). Oxygen levels ranged from 0.9 to 7.0 percent in VM-1-5 and VM-2-5 during operation in May and June (see Table 5-1). The oxygen utilization rate in VM-1-5 and VM-2-5 was 0.40 and 0.48 percent/hour, respectively, which is indicative of active respiration. In addition, TVH levels could not be measured at either VM during May and June due to flame out.

A respiration rate of 0.5 percent/hour, corresponding to a total petroleum hydrocarbon (TPH) degradation rate of approximately 9 mg TPH/kg soil/day, suggests that the site should be at values near 500 mg/kg within one season (assuming initial concentrations around 1600 mg/kg). Since operation of the biovent system has been occurring at the BV wells for over 800 days and nearly two full summers at the AIW area, the BXSS should have TPH values below preliminary remediation goals (PRGs). Since oxygen utilization rates at the VMs have been somewhat constant throughout the bioventing period, it appears that biodegradation is limited (i.e., due to lack of supplied air or an abundance of moisture).

Overall Recommendation for BXSS: During the winter months, the air injection rate should be kept at the design flow rate in the BV wells to maximize the potential for aeration of the deeper intervals. Soil samples will have been collected by the end of the summer of 1998. Sampling locations are included near the BXSS Wetland (high headspace sampling sites; see Figure 5-1) and the background MP4BG area. If bioventing is continued, it is recommended that one or more AIWs be added near the high headspace readings noted in the last semiannual report (see Figure 5-1 for the proposed location). If TPH concentrations have not declined significantly from initial conditions (i.e., less than 30 percent decrease) or PRGs have been met, bioventing should cease and other remedial options should be evaluated. A lack of a decrease in TPH concentrations is likely due to oxygen-limiting conditions (low-permeability soils) as indicated in VM-1 and VM-2.



FID HEADSPACE RESULTS (ppmv) JULY 30, 1997		
	HS3	HS5
AVERAGE	436	2704
RANGE (3 SAMPLES)	315-520	1168-5449

MONITORING POINT W/DEPTH	OXYGEN LEVEL (O_2 %)		
	1/98 THROUGH 4/98	5/98	6/98
VM-1-5	NO SOIL GAS SAMPLES COLLECTED DUE TO WINTER CONDITIONS	7.0	4.7
VM-1-8		NF	5.3
VM-2-5		1.3	0.9
VM-2-8		NF	NF
VM-3-5		19.7	20.5
VM-3-8		NF	20.5
MP-1-3.5		NF	13.3
MP-1-7.5		20.7	18.0
MP-2-3.5		19.5	20.0
MP-2-8.5		19.8	18.2
MP-3-3.5		WATER	17.3
MP-4BG-8		18.8	16.8

MONITORING POINT W/DEPTH	SEPT 1996 OXYGEN UTIL RATE %/HR	JUNE 1997 OXYGEN UTIL RATE %/HR	OCT 1997 OXYGEN UTIL RATE %/HR	JUNE 1998 OXYGEN UTIL RATE %/HR
VM-1-5	0.71	0.49	0.52	0.40
VM-2-5	0.11	0.50	NT	0.48
MP-1-3.5	NT	NT	NT	0.30
MP-1-7.5	0.1	0.08	0.12	WATER
MP-2-8.5	1.1	0.11	0.29	0.14
MP-3-3.5	NT	NT	NT	0.08
MP-4BG-8	1.3	WATER	NT	0.07

BOREHOLE HEADSPACE RESULTS (ppmv) (SEE BEI 1998a FOR DETAILS)		
BOREHOLE	MAX READING	DEPTH (FT)
BH-1	2.4	2-4
BH-2	1.6	2-4
BH-3	19.7	2-4

22784/043/FIG3-5.DGN

Figure 5-1
BXSS Biovent System Layout and Average Wellhead Flow

Table 5-1 BXSS Air Flow and Monitoring Point Data

Air Injection Well	Screen Interval ft/bgs top[1]	bottom[1]	Overburden Pressure[2] (psi)	Design Air Flow (scfm)	Individual Well Head Flow (scfm) January 1998	February 1998	March 1998	April 1998	May 1998	June 1998	Average Jan - Jun
BV-1	9.3	29.5	6.5	2	3	3	3	2	2	3	2.7
BV-2	8.3	28.4	5.8	2	3	3	3	2	2	3	2.7
BV-3	5.5	25.7	3.8	2	3	3	3	2	3	3	2.8
AIW-1	7	12	4.9	2	2	2	2	2	2	2	2.0
AIW-2	9	14	6.3	2	2	2	2	2	2	2	2.0
AIW-3	8	13	5.6	2	2	2	2	2	2	2	2.0
AIW-4	6	11	4.2	2	2	2	2	2	2	2	2.0
Total air flow:				14	17.0	17.0	17.0	14.0	15.0	17.0	
Pressure (psi):					2.2	2.6	2.2	2	1.8	1.8	

Monitoring Point	Screen Interval (ft bgs) top	bottom		Soil Gas Sampling Results January 1998 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	February 1998	March 1998 O_2 (%)	CO_2 (%)	TVH (ppmv)	April 1998 O_2 (%)	CO_2 (%)	TVH (ppmv)	May 1998 O_2 (%)	CO_2 (%)	TVH (ppmv)	June 1998 O_2 (%)	CO_2 (%)	TVH (ppmv)
VM-1-5	5	5.5	O_2 Util. Rate = 0.40%/hr[3]	No Soil Gas			No Soil Gas	No Soil Gas			No Soil Gas			7.0	5.7	flame out	4.7	10.7	flame out
VM-1-8	8	8.5		Samples Collected			Samples Collected	Samples Collected			Samples Collected				no flow		5.3	2.1	flame out
VM-2-5	5	5.5	O_2 Util. Rate = 0.48%/hr[3]	due to Winter Conditions			due to Winter Conditions	due to Winter Conditions			due to Winter Conditions			1.3	7.5	flame out	0.9	14.0	flame out
VM-2-8	8	8.5													no flow			no flow	
VM-3-5	5	5.5												19.7	0.0	0.0	20.5	0.0	9.4
VM-3-8	8	8.5													no flow		20.5	0.0	8.9
MP-1-3.5	3.5	4	O_2 Util. Rate = 0.30%/hr[3]												no flow		13.3	6.2	43
MP-1-7.5	7.5	8	O_2 Util. Rate = 0.12%/hr[3]											20.7	0.9	0.22	18.0	1.4	1.2
MP-2-3.5	3.5	4												19.5	1.3	0	20.0	1.1	3.4
MP-2-8.5	8.5	9	O_2 Util. Rate = 0.14%/hr[3]											19.8	0.9	2.8	18.2	0.9	9.5
MP-3-3.5	3.5	4	O_2 Util. Rate = 0.08%/hr[3]												water		17.3	3.3	1.1
MP-4BG-8	8	8.5	O_2 Util. Rate = 0.07%/hr[3]											18.8	2.5	0.3	16.8	2.8	1.6

[1] Measured from top of casing in AIW wells only. MPs measured from ground surface.

[2] Maximum pressure before potential for fracturing of soil. Calculated at top of screen assuming density of soil is 100 lbs/ft^3.

[3] Test performed on 6/25/98.

bgs = below ground surface, nr = no reading

NOTE: Flame out occurs due to low oxygen levels.

Table 5-2 BXSS Groundwater Level Data

Base Exchange Service Station Groundwater Levels from January through June 1998

Well No.	Well Depth below TOC[1]	Top of Screen below TOC[1]	Jan-98	Feb-98	Mar-98	Apr-98	May-98	Jun-98
BV-1	29.5	9.3	10.6	11	11	8.3	8.6	8.9
BV-2	30	9.8	9.9	9.9	9.2	8.7	9.3	11
BV-3	25.7	5.5	10.7	11.1	9.2	8.8	8.9	8.9
AIW-1	15	7	15	15	15	8.9	9.8	10.4
AIW-2	17	9	17	17	11.2	10.4	10.9	11
AIW-3	16	8	16	16	12.2	9.9	11	11.1
AIW-4	14	6	14	14	14	14.3	14.4	14

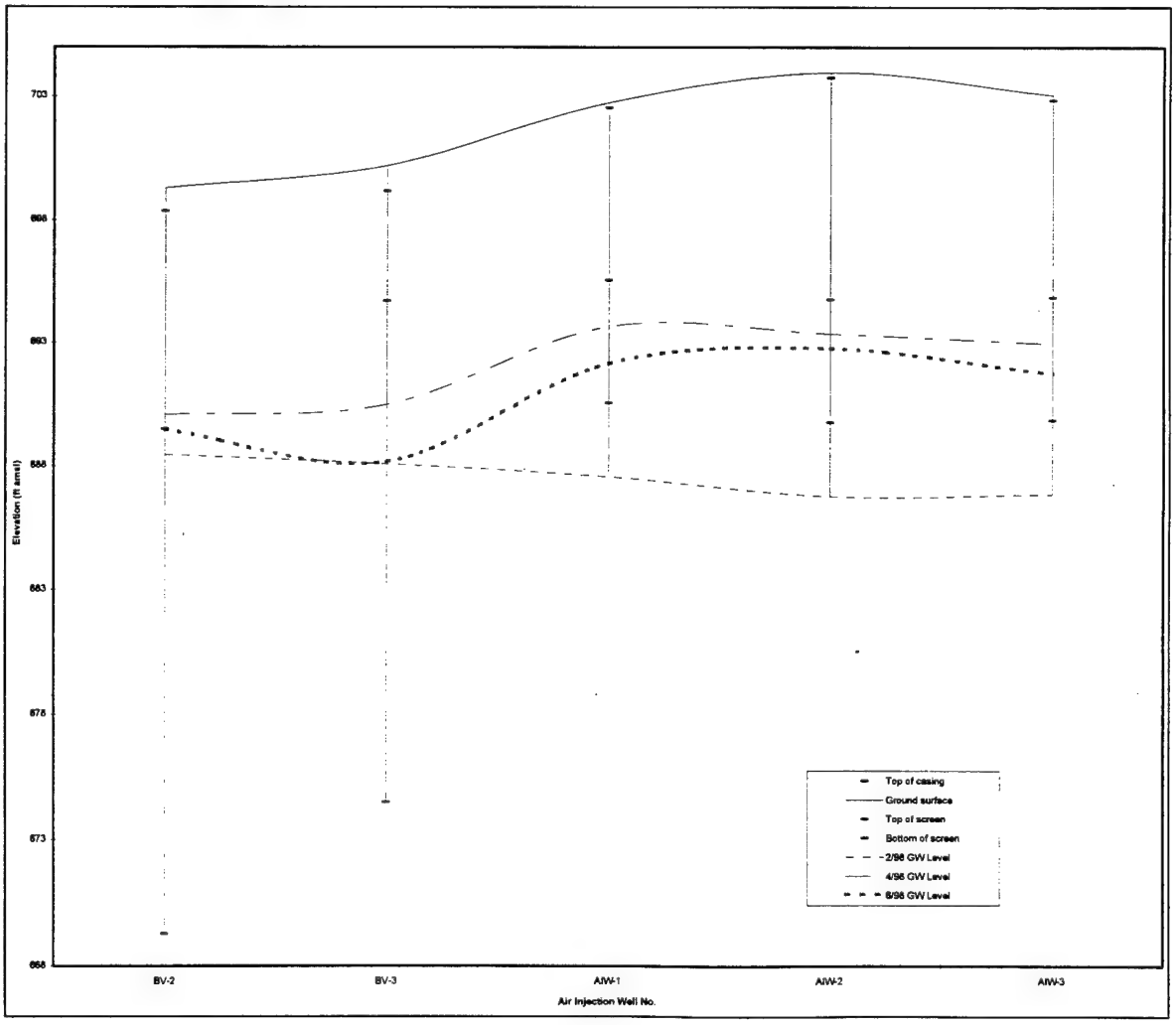
[1] Depth at BV wells are from ground surface. Depth to groundwater from TOC located approximately 1.5 ft bgs.
nc = not collected
Bolded value indicates groundwater depth is at or above the top of screen.

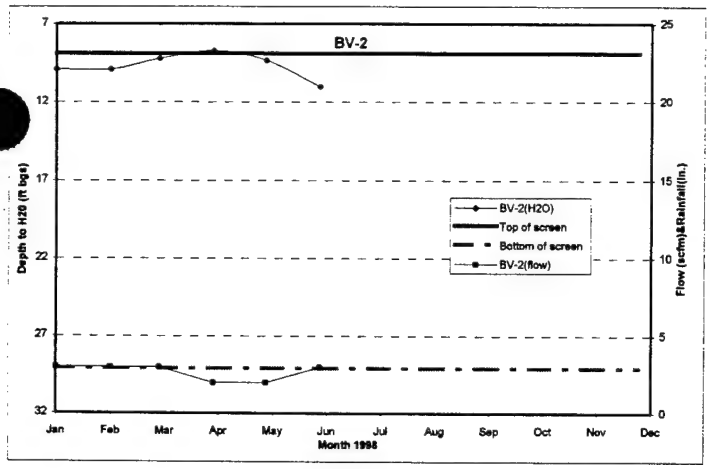
Groundwater Levels along North / South Transect at BXSS (see Figure 5-1 for transect)

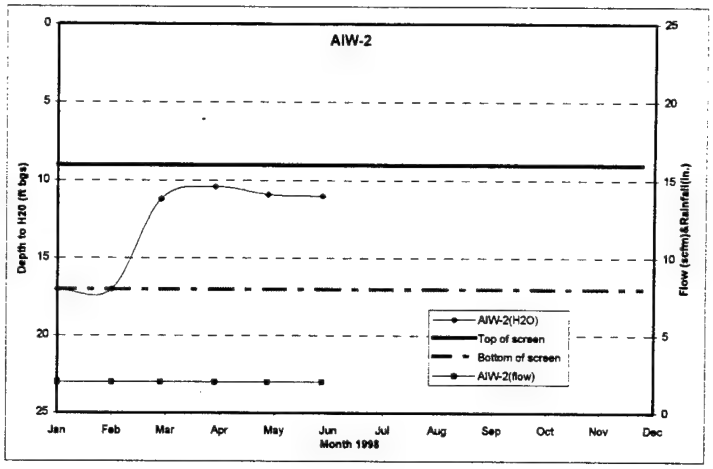
Well No.	Elevation at top of casing (ft amsl)	Approx elev. of ground (ft amsl)[2]	Elevation of water - FEB. (ft amsl)	Elevation of water - APR. (ft amsl)	Elevation of water - JUN. (ft amsl)	Depth to top of screen (ft)	Elevation to TOS (ft amsl)	Depth to bottom of screen (ft)	Elevation to BOS (ft amsl)
BV-2	698.36	699.29	688.46	690.06	689.46	9.8	689.49	30	669.29
BV-3	699.18	700.21	688.08	690.48	688.18	5.5	694.71	25.7	674.51
AIW-1	702.56	702.76	687.56	693.66	692.16	7	695.56	12	690.56
AIW-2	703.77	703.97	686.77	693.37	692.77	9	694.77	14	689.77
AIW-3	702.86	703.06	686.86	692.96	691.76	8	694.86	13	689.86

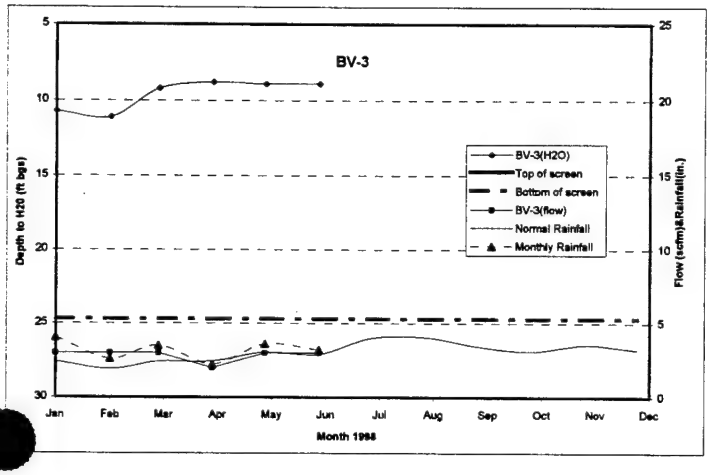
[2] Ground surface elevation estimated to be approximately 0.2 ft above the riser.

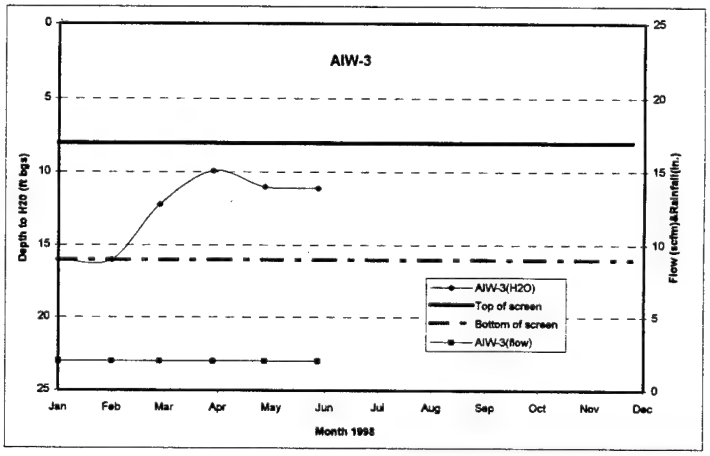
North / South Cross Section at BXSS

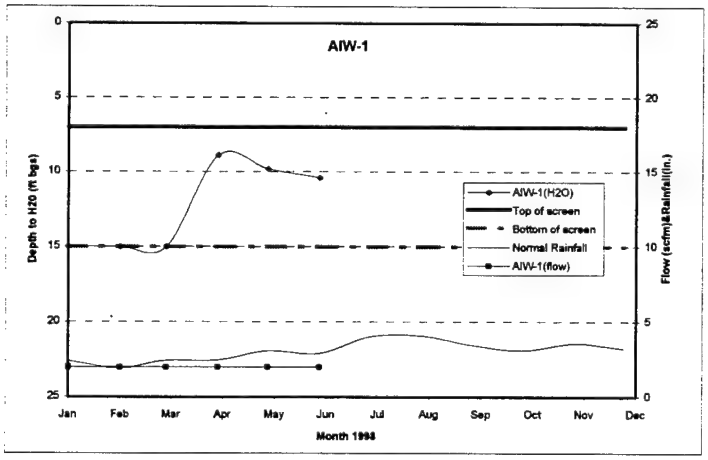












NOTE: See Figure 5-1 for transect location.

Figure 5-2 BXSS Groundwater/Air Flow Relations Along North/South Section

6.0 ENTOMOLOGY SHOP

6.1 OPERATIONS

The ES, located in OU 10, consists of 7 AIWs and 13 MPs (Figure 6-1). BEI installed the ES biovent system in the summer of 1996, startup was in September 1996, and O&M began in October 1996. Three new MPs were added to the system in July 1997 due to lack of monitoring data. The system operated a total of 620 days through June 30, 1998.

The average air flow in AIWs-2,- 3, -5, and -6 was between 1.1 and 2.4 scfm (below the design flow rate of 3 scfm) during the reporting period. AIWs-1, -4, and -7 had zero air injection flow rates. Only MP-5-9.5 was unable to supply soil gas samples during May and June (Table 6-1). All other MPs are producing air samples.

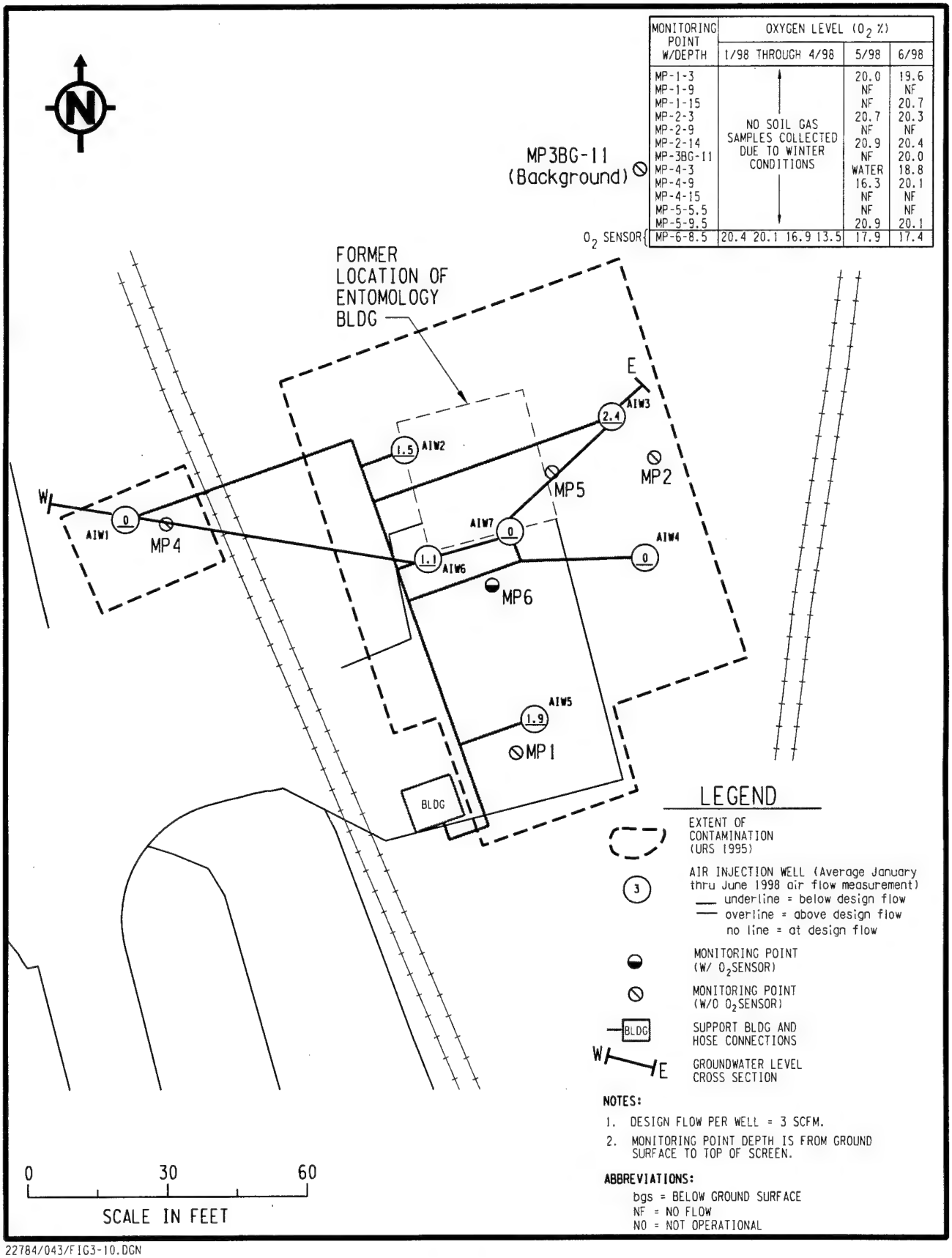
6.2 CONCLUSIONS AND RECOMMENDATIONS

Figure 6-2 illustrates the air flow and groundwater level relationship along the west/east cross section identified on Figure 6-1. Groundwater level measurements show that AIW-2 was fully inundated with water for the entire period from January through June (Table 6-2). AIW-2 continually takes air near the design rate even if the water is at or slightly above the top of the screen. High water levels during March through May resulted in zero air flow into AIW-2. AIW-3 was fully inundated in January and April, and AIW-7 was inundated in April; otherwise, the remaining AIWs had no groundwater inundation. AIWs-1, -4, and -7 have not accepted air since operation began. Groundwater appears to remain at or below the bottom of the screen most of the time; therefore, extremely impermeable soils may surround the filter pack at each of these wells.

High oxygen levels were observed at all of the MPs (17.4 to 20.9 percent) during the reporting period. The facts that oxygen levels remain high, carbon dioxide levels remain low, and oxygen utilization rates (taken in fall 1997) are at background levels indicate that oxygenation is occurring in the soils and that biodegradation may be nearing completion. A lack of MP data still remains for the deeper sediment at MP-4. No respiration tests were performed due to saturation or high oxygen levels.

Overall Recommendation for ES: It appears that biodegradation is not occurring in the vicinity of the MPs producing soil gas samples. High oxygen levels noted in these MPs may be indicating that the source of contaminants is depleted. MP-5-9.5 and MP-6-8.5 have provided information on soils immediately adjacent to the former ES. Although it appears these soils are not contaminated, it is still unknown whether soils located below the former ES basement have been affected by the air injection. It is recommended that the air injection rate at AIWs adjacent to the basement remain at an increased level during the remainder of operations at the ES. Confirmation

sampling throughout the ES site including the soils below the former basement will occur in August 1998. If petroleum contamination still exists under the former basement, a residual risk assessment may be performed to determine if further action is necessary. If further action is required, installation of additional AIW's or excavation and ex situ soil vapor extraction will be evaluated. Soils located away from the former basement appear to be approaching cleanup goals based on oxygen levels. Soil sampling results, if below PRGs, will support system shutdown. The ES building is currently targeted for use to house the Jet Engine Building Shop soil vapor extraction system/equipment. Assuming TPH levels have decreased but elevated TCE levels remain, another option would be to hook the AIWs up to the Jet Engine Buildup Shop soil vapor extraction system and extract volatiles.



22784/043/FIG3-10.DGN

Figure 6-1
ES Biovent System Layout
and Average Wellhead Flow

Table 6 - 1 ES Air Flow and Monitoring Point Data

Air Injection Well	Screen Interval ft/bgs top	bottom	Overburden Pressure[1] (psi)	Design Air Flow (scfm)	Individual Well Head Flow (scfm) January 1998	February 1998	March 1998	April 1998	May 1998	June 1998	Average Jan - Jun
AIW-1	10.3	15.3	7.2	3	0	0	0	0	0	0	0.0
AIW-2	10.1	15.1	7.0	3	3	2.8	0	0	0	3	1.5
AIW-3	7.5	12.5	5.2	3	3	3	1.1	1.5	3	3	2.4
AIW-4	10.1	15.1	7.0	3	0	0	0	0	0	0	0.0
AIW-5	13	18	9.0	3	0	3	3	2	1.5	1.8	1.9
AIW-6	11.4	16.4	7.9	3	3	2.3	1.2	0	0	0	1.1
AIW-7	10	15	6.9	3	0	0	0	0	0	0	0.0
Total air flow:				21	9.0	11.1	5.3	3.5	4.5	7.8	
Pressure (psi):					3.5	3.2	2.5	2.4	2.8	3.5	

Monitoring Point	Screen Interval (ft bgs) top	bottom		Soil Gas Sampling Results January 1998 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	February 1998 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	March 1998 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	April 1998 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	May 1998 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	June 1998 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)
MP-1-3	3	3.5		No Soil Gas Samples Collected due to Winter Conditions			No Soil Gas Samples Collected due to Winter Conditions			No Soil Gas Samples Collected due to Winter Conditions			No Soil Gas Samples Collected due to Winter Conditions			20.0	0.4	9.1	19.6	0.7	7.3
MP-1-9	9	9.5															no flow			no flow	
MP-1-15	15	15.5															no flow		20.7	0.0	42
MP-2-3	3	3.5														20.7	0.3	96.4	20.3	0.3	130
MP-2-9	9	9.5															no flow			no flow	
MP-2-14	14	14.5														20.9	0.1	71.2	20.4	0.2	166
MP-3BG-11	6.5	11.5	Background location														no flow		20.0	0.2	22
MP-4-3	3	3.5															water		18.8	2.8	39
MP-4-9	9	9.5														16.3	3.9	275	20.1	0.5	2.5
MP-4-15	15	15.5															no flow			no flow	
MP-5-5.5	5.5	6															no flow			no flow	
MP-5-9.5	9.5	10														20.9	0.0	3	20.1	0.2	1.2
MP-6-8.5	8.5	9	O_2 Sensor	20.4	na	na	20.1	na	na	16.9	na	na	13.5	na	na	17.9	na	na	17.4	na	na

[1] Maximum pressure before potential for fracturing of soil. Calculated at top of screen assuming density of soil is 100 lbs/ft^3.
[2] The monthly O_2 sensor results is the average for month. See biovent monthly reports for daily values.
bgs = below ground surface, na = not applicable

Table 6-2 ES Groundwater Level Data

Entomology Shop Groundwater Levels from January through June 1998

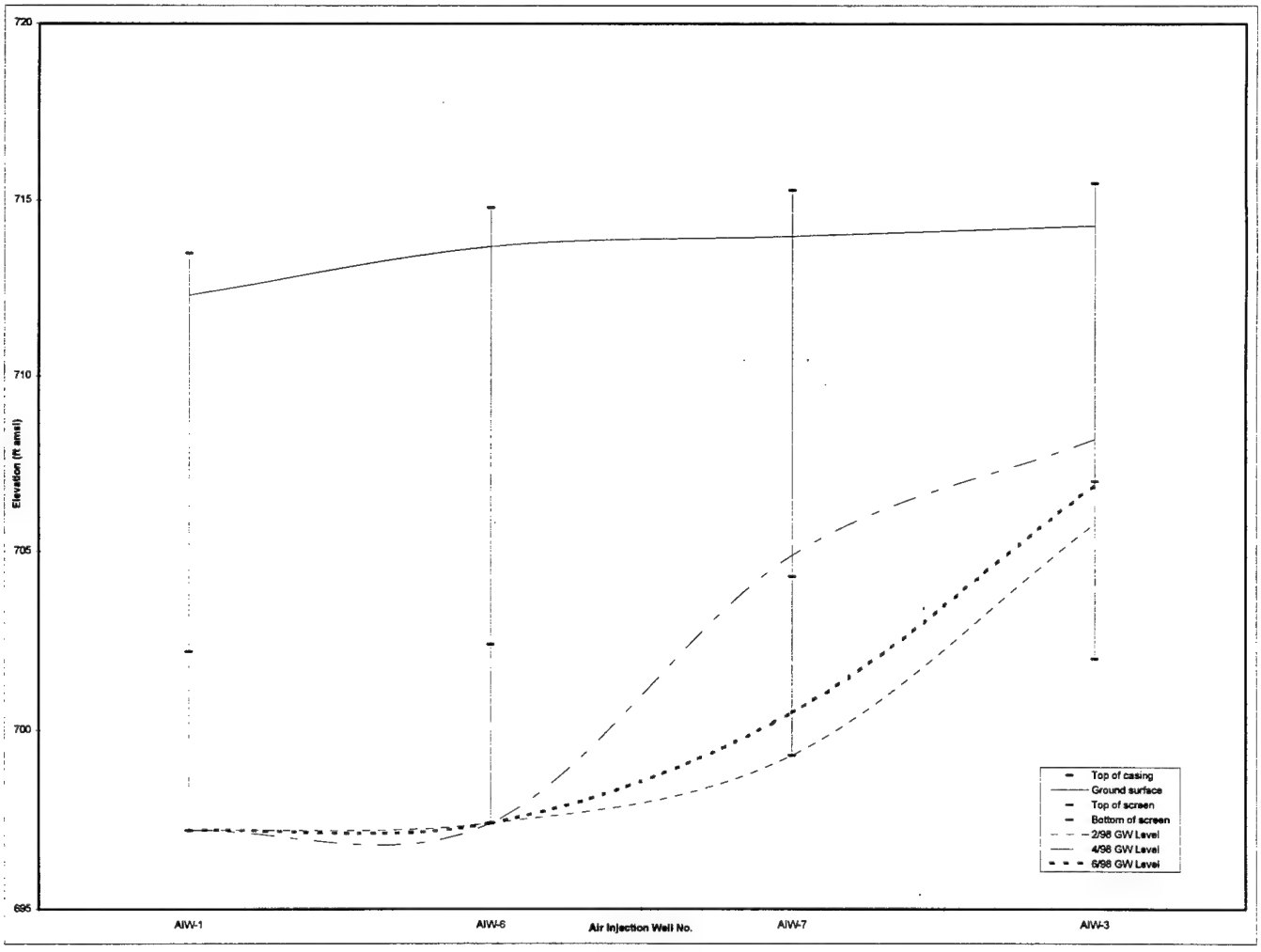
Well No.	Well Depth below TOC	Top of Screen below TOC	Jan-98	Feb-98	Mar-98	Apr-98	May-98	Jun-98
AIW-1	16.3	11.3	16.3	16.3	16.3	16.3	16.3	16.3
AIW-2	16.1	11.1	**6.8**	**8.1**	**3.9**	**4.2**	**6.6**	**9.5**
AIW-3	13.5	8.5	8.3	9.7	13.5	7.3	8.7	8.6
AIW-4	16.1	11.1	16.1	16.1	16.1	16.1	16.1	16.1
AIW-5	19	14	19	19	19	19	19	19
AIW-6	17.4	12.4	17.4	17.4	17.4	17.4	17.4	17.4
AIW-7	16	11	16	16	16	10.4	13.3	14.8

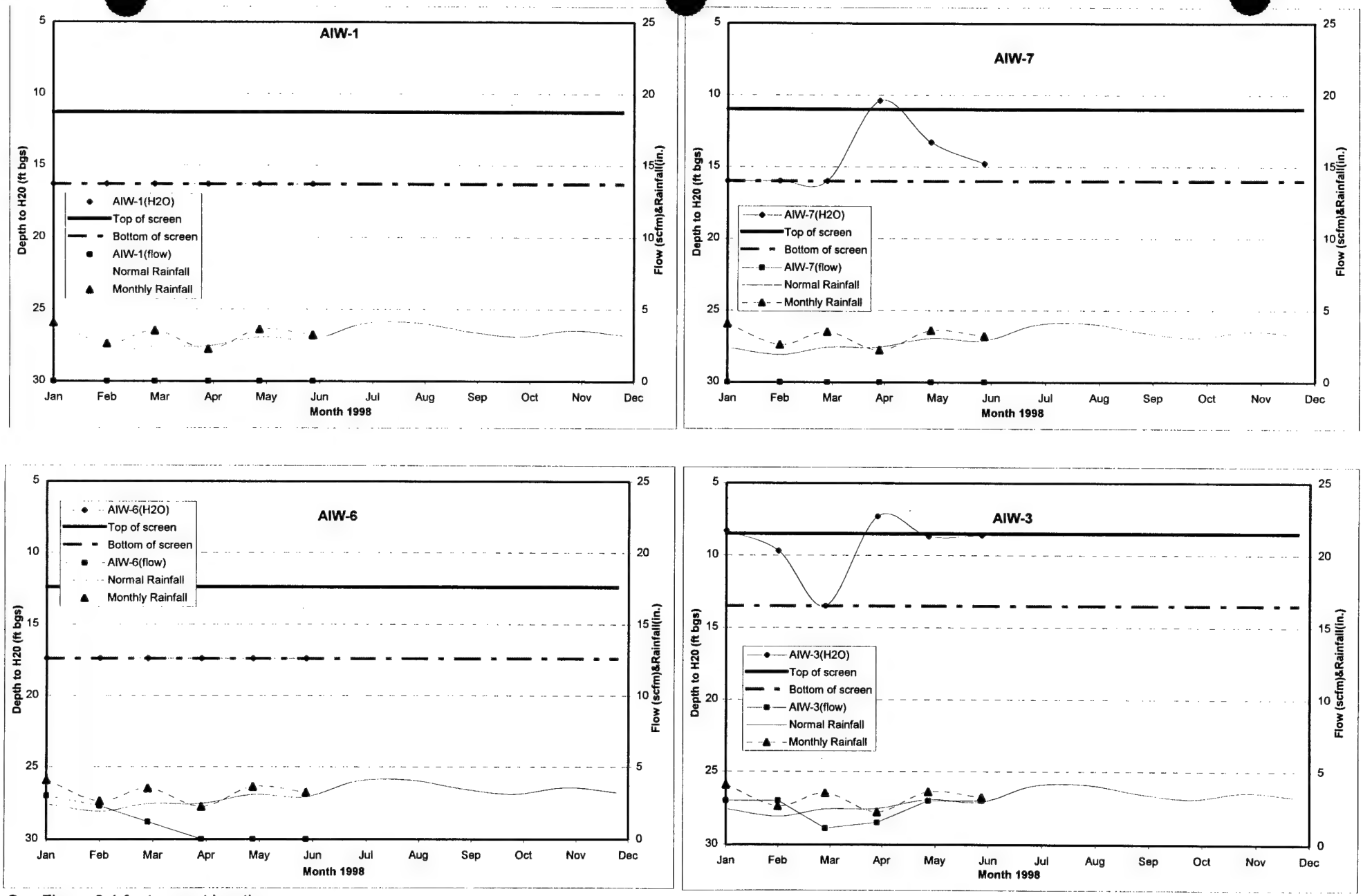
Bolded value indicates groundwater depth is at or above the top of screen.

Groundwater Levels along West / East Transect at Entomology Shop (see Figure 6-1 for transect)

Well No.	Elevation at top of casing (ft amsl)	Elevation of ground surface	Elevation of water - FEB. (ft amsl)	Elevation of water - APR. (ft amsl)	Elevation of water - JUN. (ft amsl)	Depth to top of screen (ft)	Elevation to TOS (ft amsl)	Depth to bottom of screen (ft)	Elevation to BOS (ft amsl)
AIW-1	713.5	712.3	697.2	697.2	697.2	11.3	702.2	16.3	697.2
AIW-6	714.8	713.7	697.4	697.4	697.4	12.4	702.4	17.4	697.4
AIW-7	715.3	714.0	699.3	704.9	700.5	11	704.3	16.0	699.3
AIW-3	715.5	714.3	705.8	706.2	706.9	8.5	707.0	13.5	702.0

West / East Cross Section at Entomology Shop





See Figure 6-1 for transect location.

Figure 6-2 ES Groundwater/Air Flow Relations Along West/East Section

7.0 FORMER JET ENGINE TEST CELL

7.1 OPERATIONS

The FJETC, located in OU 5, consists of 13 AIWs and 8 MPs (Figure 7-1). BEI installed FJETC biovent system in the fall of 1995; MP-8, containing an oxygen sensor, was added to the system in July 1997. This oxygen sensor was added to the north-central portion of the site because of the lack of monitoring data in this area (as a result of inundated MPs) and the presence of fuel in nearby MP-1. Since BEI assumed responsibility for O&M, this biovent system has operated 699 days through June 30, 1998. The system was down during portions of the summer and early fall 1996 due to high groundwater levels and in May 1997 due to a malfunction of the high water level switch in the desiccant tank. Two new replacement AIWs were drilled and installed (AIW-1A and AIW-12A) at the end of July 1997. These AIWs were added to increase the air flow in the northern end of FJETC. The two new AIWs have worked well since their startup in November.

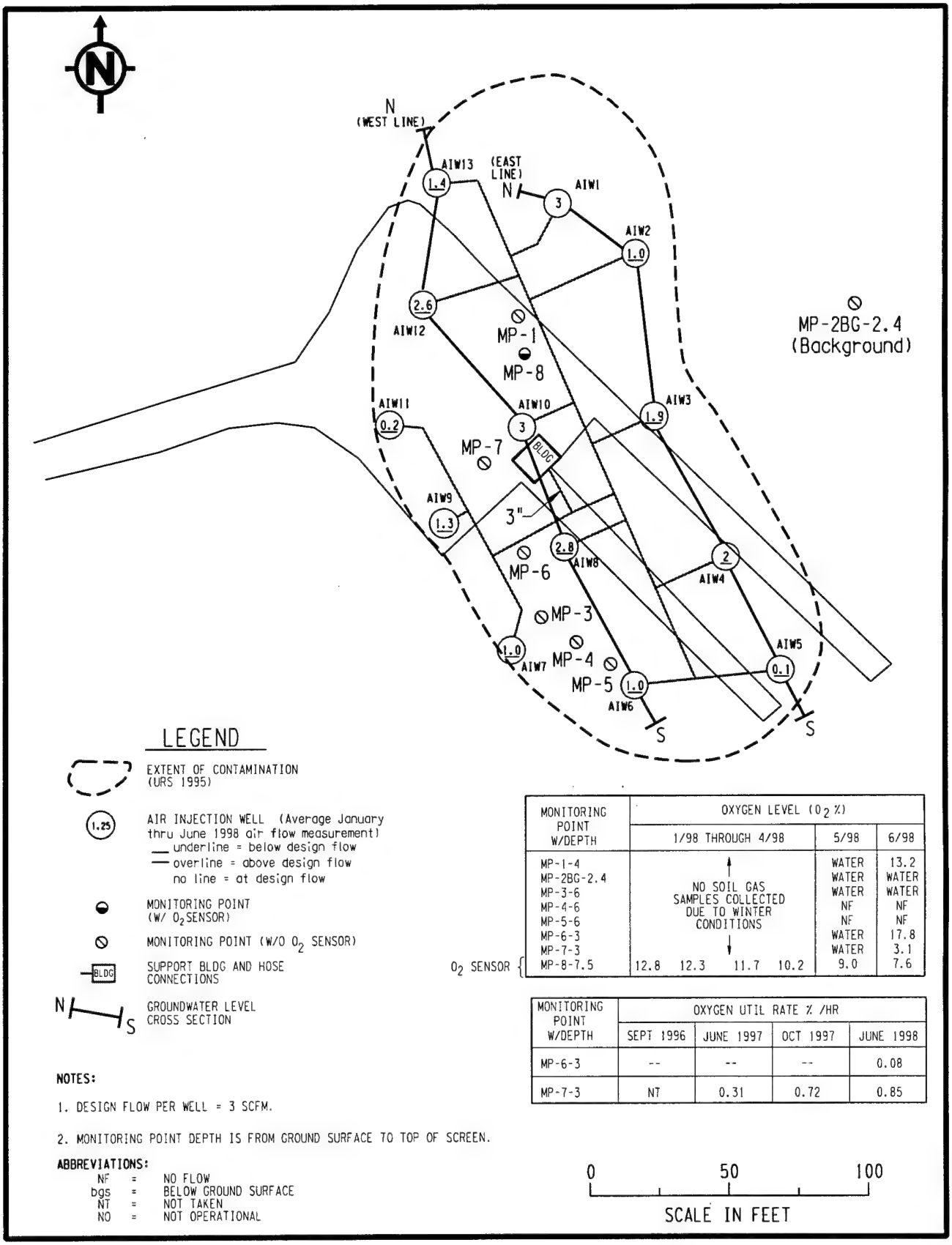
During June and July 1997, most of the AIWs did not accept flow or were shut down due to high groundwater levels. Between August 1997 and February 1998, most of the AIWs accepted air at or near the design rate. Since February, the air flow has decreased by 50 percent and approximately half the wells now do not accept air (Table 7-1). Table 7-2 illustrates February, April, and June water levels along two transects that are shown on Figure 7-1. Figures 7-2 and 7-3 present monthly groundwater levels and flow rates for each AIW located along the two transects.

Fuel was not found in MP-1-4 as observed in early summer of 1996 and July through November 1997. Soil gas collected in June from MP-1-4 did contain low oxygen at 13.2 percent. High water levels limited the collection of soil gas samples from MP-2 through MP-5 during May and June. MP-6 and MP-7 produced soil gas samples during May and June. A respiration test was performed at MP-6 and MP-7 in June as illustrated in Figure A-9 in Appendix A.

7.2 CONCLUSIONS AND RECOMMENDATIONS

In general, high water levels exist in the central and northern parts of the FJETC site (Table 7-2). This elevated groundwater has greatly reduced the amount of soil originally planned for treatment. The high oxygen level noted in MP-6 may be indicative of oxygenation of unsaturated soils and subsequent successful biodegradation. Very low oxygen levels (7.6 to 12.8 during this reporting period) in MP-8 suggest that contaminated soils still remain along with the potential of free-phase petroleum.

Overall Recommendation for FJETC: It is recommended that the system be allowed to run until confirmation soil samples have been collected throughout FJETC. Sampling is planned for August or September 1998. This information will be used to determine whether to continue or propose an alternative cleanup method (i.e., excavation or bioslurping). In addition, evaluate surface runoff features and relationship to the gravel beds just southeast of the FJETC biovent building. Implement surface water management practices (i.e., polyliner) if it is thought that groundwater levels can be lowered.



MONITORING POINT W/DEPTH	OXYGEN LEVEL (O_2 %)					
	1/98 THROUGH 4/98				5/98	6/98
MP-1-4	NO SOIL GAS SAMPLES COLLECTED DUE TO WINTER CONDITIONS				WATER	13.2
MP-2BG-2.4					WATER	WATER
MP-3-6					WATER	WATER
MP-4-6					NF	NF
MP-5-6					NF	NF
MP-6-3					WATER	17.8
MP-7-3					WATER	3.1
MP-8-7.5	12.8	12.3	11.7	10.2	9.0	7.6

MONITORING POINT W/DEPTH	OXYGEN UTIL RATE % /HR			
	SEPT 1996	JUNE 1997	OCT 1997	JUNE 1998
MP-6-3	--	--	--	0.08
MP-7-3	NT	0.31	0.72	0.85

22784/043/FIG3-11.DGN

Figure 7-1
FJETC Biovent System Layout
and Average Wellhead Flow

Table 7 - 1 FJETC Air Flow and Monitoring Point Data

Air Injection Well	Screen Interval ft/bgs top	bottom	Overburden Pressure[1] (psi)	Design Air Flow (scfm)	Individual Well Head Flow (scfm) January 1998	February 1998	March 1998	April 1998	May 1998	June 1998	Average Jan - Jun
AIW-1	7.8	12.8	5.4	3	3	3	3	3	3	3	3.0
AIW-2	7.9	12.8	5.5	3	1.7	2	1	1	0	0	1.0
AIW-3	6.9	11.8	4.8	3	3	3	0	1	1.3	3	1.9
AIW-4	2	6	1.4	3	3	3	off	0	off	off	2.0
AIW-5	6.9	11.8	4.8	3	0	0	0	0.5	0	0	0.1
AIW-6	6.8	11.8	4.7	3	3	2.8	0	0	0	0	1.0
AIW-7	7.9	12.8	5.5	3	3	3	0	0	0	0	1.0
AIW-8	2	7	1.4	3	3	3	2	3	3	3	2.8
AIW-9	8.9	13.8	6.2	3	3	3	1.5	0	0	0	1.3
AIW-10	2	8.5	1.4	3	3	3	3	3	3	3	3.0
AIW-11	7.8	12.8	5.4	3	0.5	0.8	0	0	0	0	0.2
AIW-12	8.9	13.8	6.2	3	3	3	1.5	2	3	3	2.6
AIW-13	7.8	12.8	5.4	3	3	3	1.5	0	0	1	1.4
Total air flow:				39	32.2	32.6	13.5	13.5	13.3	16.0	
Pressure (psi):					3.4	3.3	2.7	2.7	2.4	3.4	

Monitoring Point	Screen Interval (ft bgs) top	bottom		Soil Gas Sampling Results January 1998 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	February 1998 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	March 1998 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	April 1998 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	May 1998 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	June 1998 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)
MP-1-4	4	4.5		No Soil Gas			No Soil Gas			No Soil Gas			No Soil Gas				water		13.2	5.2	flame out
MP-2BG-2.4	2.4	8	Background location	Samples Collected			Samples Collected			Samples Collected			Samples Collected				water			water	
MP-3-6	6	6.5		due to Winter Conditions			due to Winter Conditions			due to Winter Conditions			due to Winter Conditions				water			water	
MP-4-6	6	6.5															no flow			no flow	
MP-5-6	6	6.5															no flow			no flow	
MP-6-3	3	3.5	O_2 Util. Rate = 0.08%/hr[3]														water		17.8	3.6	7.1
MP-7-3	3	3.5	O_2 Util. Rate = 0.85%/hr[3]														water		3.1	10.7	flame out
MP-8-7.5	7.5	8	O_2 sensor	12.8	na	na	12.3	na	na	11.7	na	na	10.2	na	na	9.0	na	na	7.6	na	na

[1] Maximum pressure before potential for fracturing of soil. Calculated at top of screen assuming density of soil is 100 lbs/ft^3.
[2] The monthly O_2 sensor results is the average for month. See biovent monthly reports for daily values.
[3] Test performed on 7/1/98.
nr = no reading, bgs = below ground surface, no = not operational.

NOTE: AIW's that are noted to be "off" have been shutdown due to well seal leaks.

NOTE: Flame out occurs due to low oxygen levels.

Table 7-2 FJETC Groundwater Level Data

Former Jet Engine Test Cell Groundwater Levels from January through June 1998

Well No	Well Depth below TOC	Top of Screen below TOC	Jan-98	Feb-98	Mar-98	Apr-98	May-98	Jun-98
AIW-1	15.1	9.9	15.3	14	12.3	7.2	9	9.3
AIW-2	15.0	9.9	14	14	14	8.9	11	14.2
AIW-3	13.8	8.7	8.6	8.6	7.5	8.15	8.3	9.2
AIW-4	8.0	4.0	3.9	4.4	2.1	3.4	2.65	2.8
AIW-5	13.6	8.7	13	13	13	9.75	8.9	12.8
AIW-6	14.1	8.9	13	13	13	8.7	10	13.3
AIW-7	15.0	9.9	14	14	14	7.5	9.8	13.2
AIW-8	8.6	3.6	5.5	5.7	3.4	3.3	3.9	4.2
AIW-9	15.8	10.7	15	15	15	9.3	11.4	14.6
AIW-10	10.3	3.8	6.9	7	4.4	4.4	5.1	5.3
AIW-11	14.8	9.6	14	14	14	11.4	10.8	11.9
AIW-12	15.8	10.7	10.7	10.5	7.5	8.31	7.5	7.3
AIW-13	15.0	9.8	14	14	14	7.2	8	11.3

Bolded value: indicates water level is at or above the top of the screen.

Groundwater Levels along North / South (Westline) Transect at FJETC

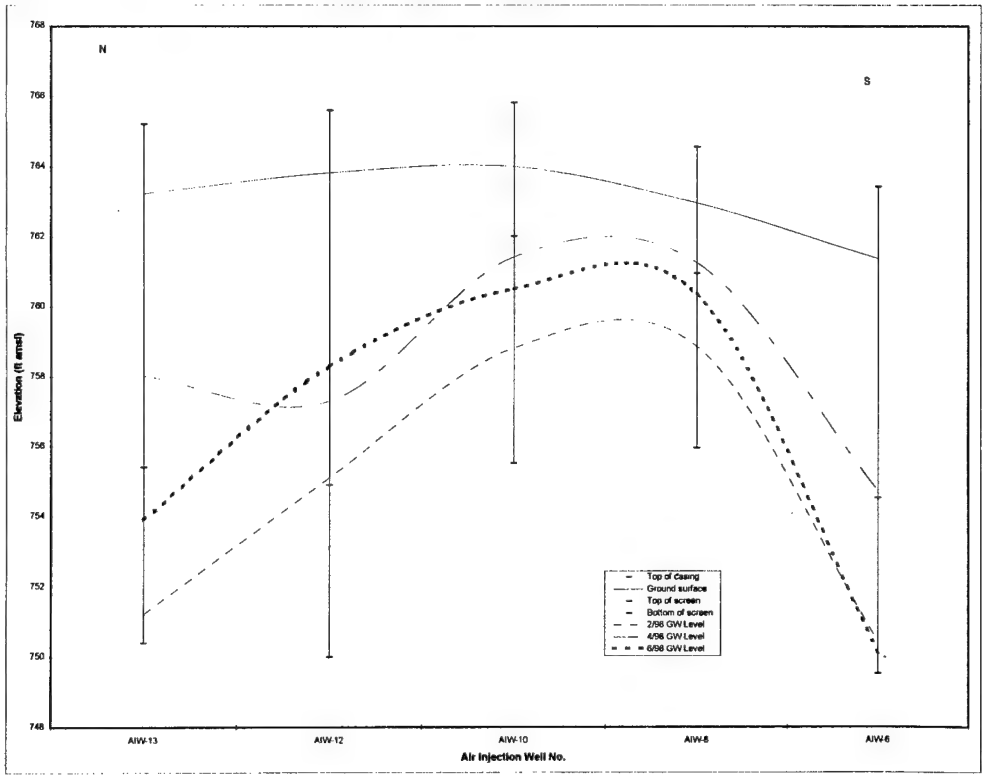
Well No.	Elevation at top of casing (ft amsl)	Elevation of ground (ft amsl)	Elevation of water - FEB. (ft amsl)	Elevation of water - APR. (ft amsl)	Elevation of water - JUN. (ft amsl)	Depth to top of screen (ft)	Elevation to TOS (ft amsl)	Depth to bottom of screen (ft)	Elevation to BOS (ft amsl)
AIW-13	765.21	763.23	751.21	758.01	753.91	9.8	755.41	14.8	750.41
AIW-12	765.80	763.82	755.10	757.29	758.3	10.7	754.9	15.8	750
AIW-10	765.82	763.99	758.82	761.42	760.52	3.8	762.02	10.3	755.52
AIW-8	764.56	762.96	758.86	761.26	760.36	3.6	760.96	8.6	755.96
AIW-6	763.43	761.38	750.43	754.73	750.13	6.9	754.53	13.9	749.53

Groundwater Levels along North / South (Eastline) Transect at FJETC

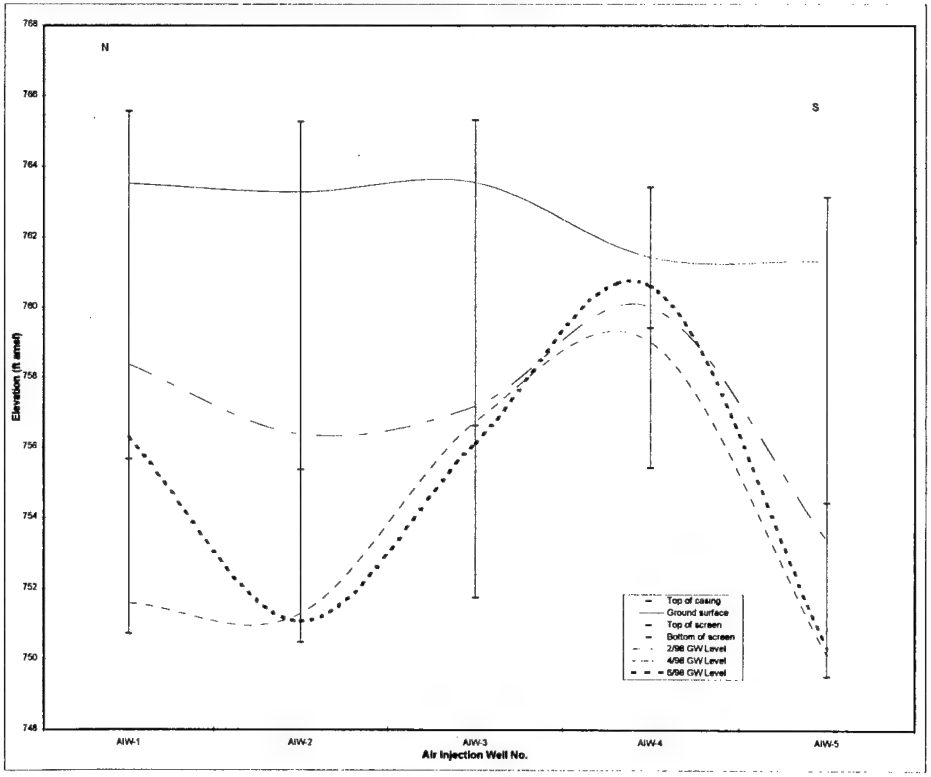
Well No.	Elevation at top of casing (ft amsl)	Elevation of ground (ft amsl)	Elevation of water - FEB. (ft amsl)	Elevation of water - APR. (ft amsl)	Elevation of water - JUN. (ft amsl)	Depth to top of screen (ft)	Elevation to TOS (ft amsl)	Depth to bottom of screen (ft)	Elevation to BOS (ft amsl)
AIW-1	765.57	763.52	751.57	758.37	756.27	9.9	755.673	14.9	750.719
AIW-2	765.27	763.28	751.27	756.37	751.07	9.9	755.372	14.8	750.479
AIW-3	765.32	763.55	756.72	757.17	756.12	8.7	756.622	13.6	751.747
AIW-4	763.42	761.43	759.02	760.02	760.62	4	759.42	8.0	755.429
AIW-5	763.14	761.32	750.14	753.39	750.34	8.7	754.44	13.6	749.523

Bolded value: indicates water level is at or above the top of the screen.

North / South Cross Section at FJETC - Westline (see Figure 7-1 for transect)



North / South Cross Section at FJETC - Eastline (see Figure 7-1 for transect)



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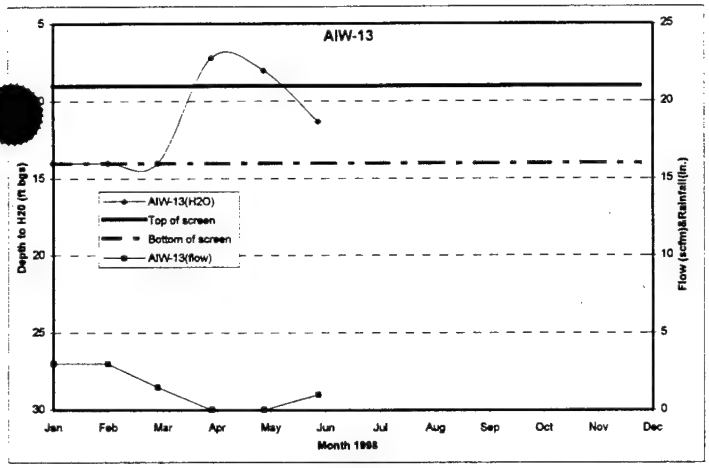
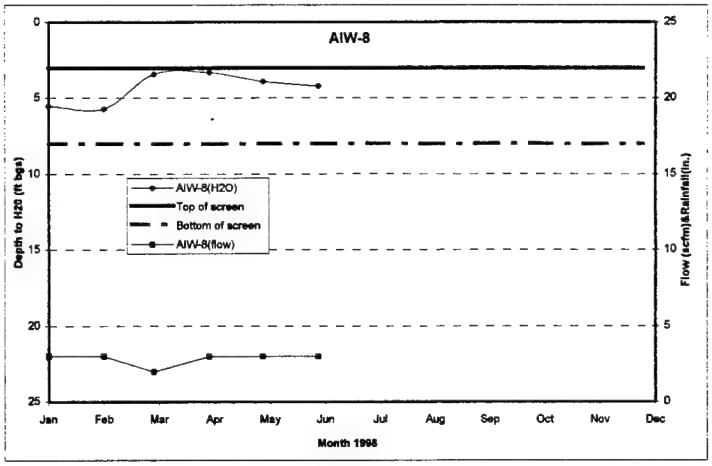
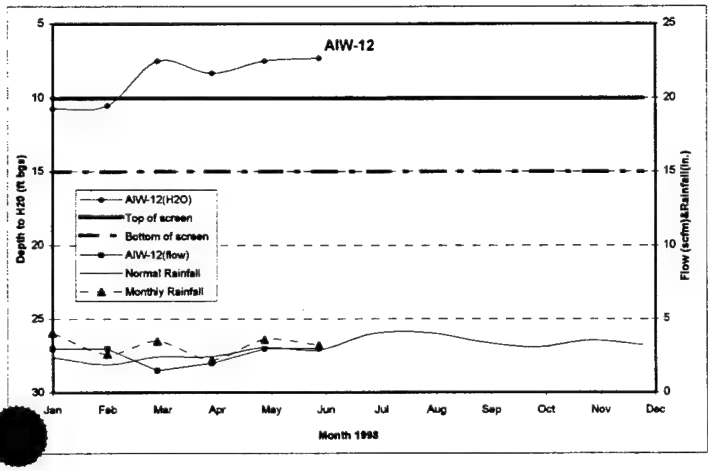
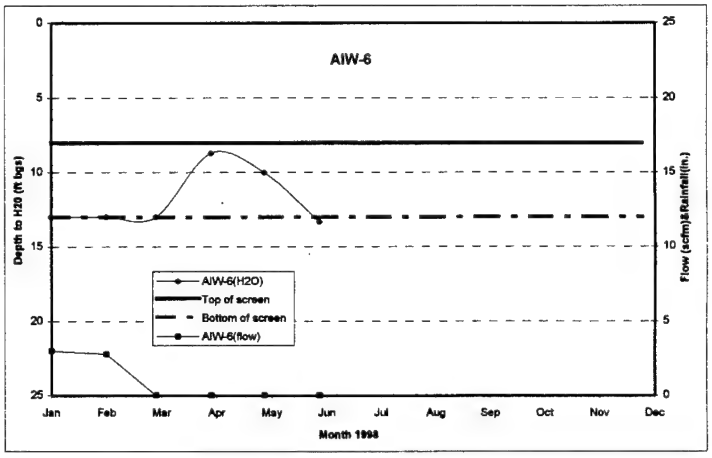
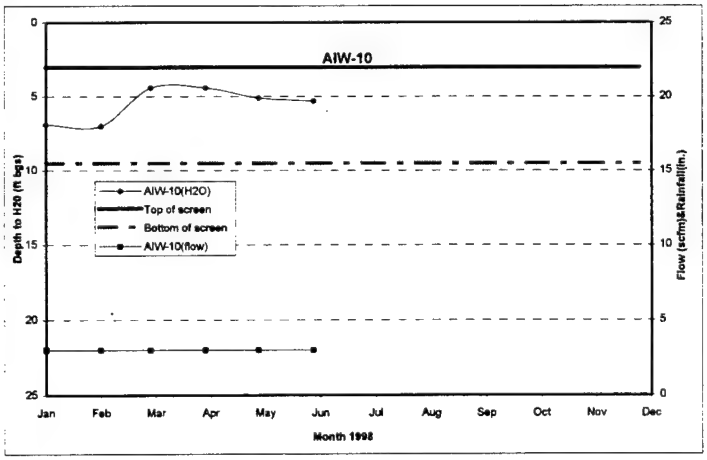




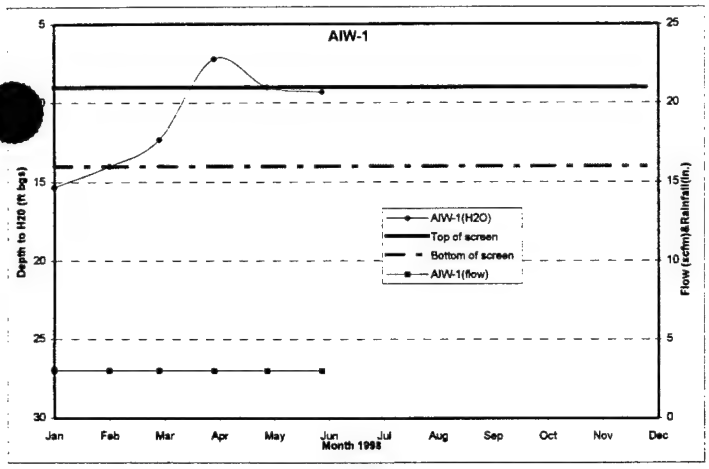


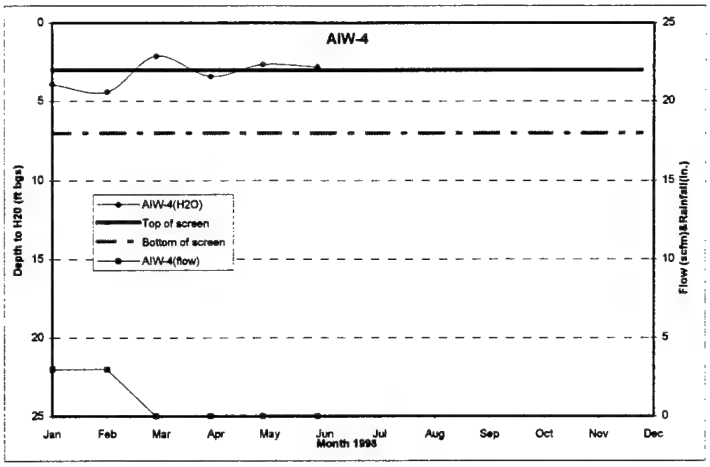


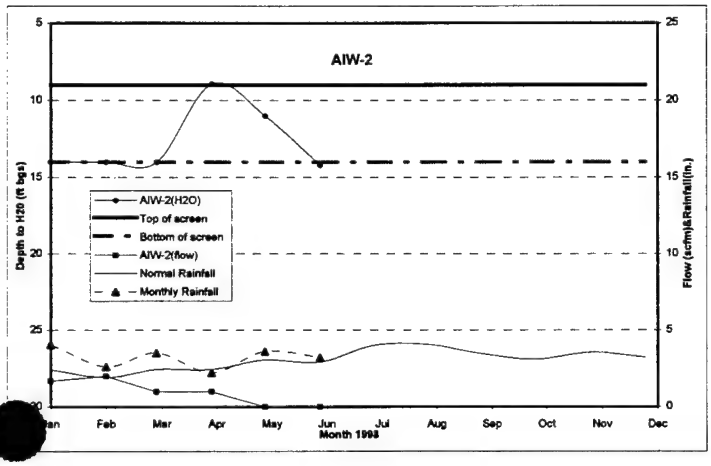


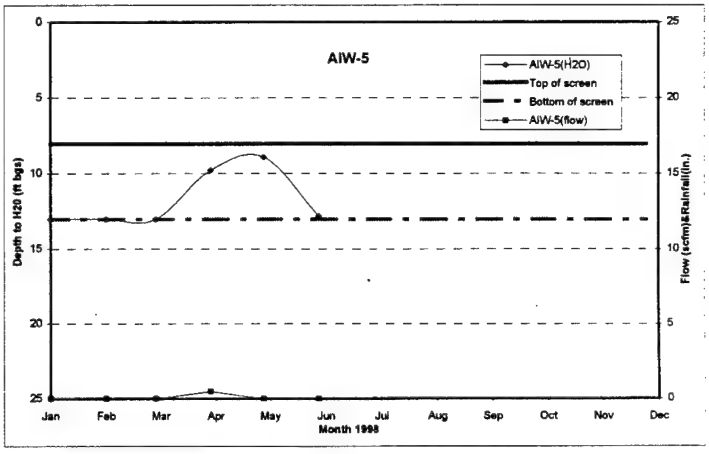
NOTE: See Figure 7-1 for transect location

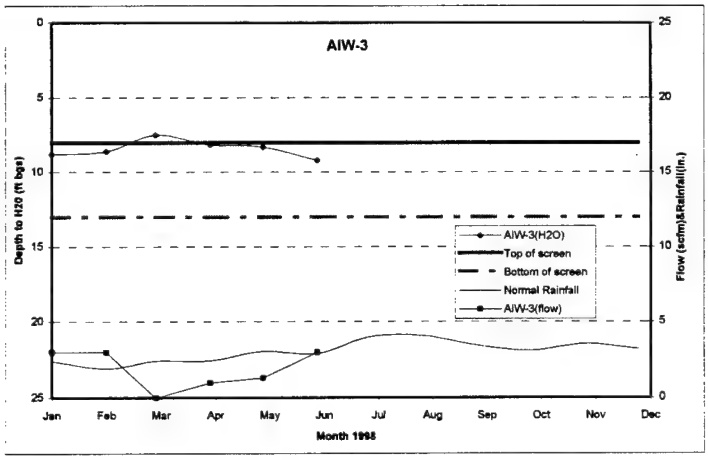
Figure 7-2 FJETC Groundwater/Air Flow Relations Along North/South Section (Westline)











NOTE: See Figure 7-1 for transect location.

Figure 7-3 FJETC Groundwater/Air Flow Relations Along North/South Section (Eastline)

8.0 FIRE TRAINING AREA

8.1 OPERATIONS

The FTA, located in OU 8, consists of 16 AIWs and 38 MPs (Figure 8-1). BEI installed the FTA biovent system in the fall of 1995. Since BEI assumed responsibility for the bioventing O&M, the system had operated 820 days through June 30, 1998. The only oxygen sensor (MP-16) was installed in July 1997, as shown in Figure 8-1. Minor interruptions for respiration testing and general maintenance have occurred since startup. Several power outages have also occurred at this site since startup, resulting in brief shutdowns.

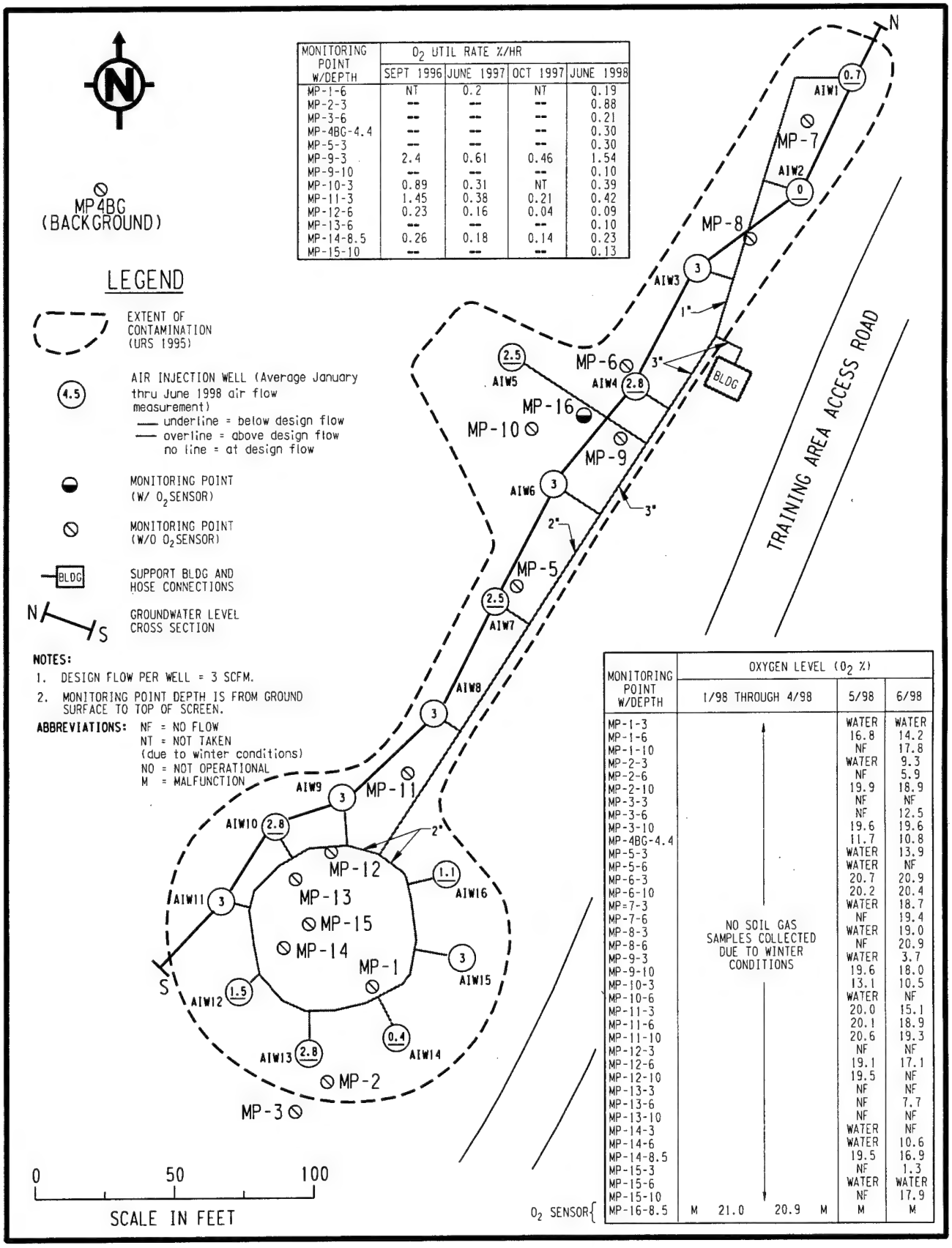
Injection flows are typically held at or slightly above the design flow rate of 3 scfm in each AIW. AIW-2 has not accepted injected air since system startup. AIWs-1, -12, -14, and -16 have consistently been below the design flow rate, typically one-half of the 3 scfm or less. AIWs-12, -14, and -16 are all located in the southern end around the former fire pit; this area is also where most of the inundated MPs exist. The overall system injection pressure fluctuated between 2 and 4.2 psi (Table 8-1) throughout the reporting period. The typical pressure was near 3.7 psi, but the rate was reduced to 2 psi during the wet period in April in order not to compromise the well seals.

8.2 CONCLUSIONS AND RECOMMENDATIONS

Only 11 of the 38 FTA MPs did not produce soil gas samples. Unexpectedly, 6 of the 11 nonproductive MPs have bottom of screen depths at 3.5 ft bgs (see Table 8-1). A clay lens may be intersecting these shallow MPs. Table 8-2 presents groundwater levels in AIWs and a cross-sectional view of the generalized water table for February, April, and June 1998. It is clear that groundwater levels are not a problem at this site—only one of the AIWs had water greater than 1 ft above the bottom of the 5- and 6-ft screens. Figure 8-2 presents the groundwater levels and air flows per AIW along the north-south cross section on Figure 8-1. The average and normal monthly rainfall curve has been added to the first two AIW graphs on Figure 8-2 for comparison to groundwater levels.

Thirteen respiration tests were run in June; the pretest oxygen level ranged from 3.7 to 17.9 percent (Figures A-10 and A-16). Pretest oxygen levels are those measured after the system has been shut down for a minimum of 24 hours before helium and air are injected. Seven of the 13 tests were performed on MPs that did not have any previous respiration test data (see Table 3-1). In general, all oxygen utilization rates in MPs previously tested showed levels similar to 1997 rates. Most of the new tests (MPs not previously tested) indicated that biodegradation is still occurring.

Overall Recommendation for FTA: No changes to the system are recommended; in general, the system appears to be operating as designed. Comparison of the spring 1998 oxygen utilization rates with the previous reports shows that biodegradation is still occurring although contamination may remain in various locations throughout the site. A decline in oxygen utilization rates since startup suggests enhanced biodegradation has occurred. Soil samples that will be collected during the summer of 1998 should be evaluated as soon as possible. Delineation of contaminated soils should be made with this information and soils that remain above PRGs should be evaluated for another remedial alternative (i.e., excavation and disposal in LF-3).



MONITORING POINT W/DEPTH	O_2 UTIL RATE %/HR			
	SEPT 1996	JUNE 1997	OCT 1997	JUNE 1998
MP-1-6	NT	0.2	NT	0.19
MP-2-3	--	--	--	0.88
MP-3-6	--	--	--	0.21
MP-4BG-4.4	--	--	--	0.30
MP-5-3	--	--	--	0.30
MP-9-3	2.4	0.61	0.46	1.54
MP-9-10	--	--	--	0.10
MP-10-3	0.89	0.31	NT	0.39
MP-11-3	1.45	0.38	0.21	0.42
MP-12-6	0.23	0.16	0.04	0.09
MP-13-6	--	--	--	0.10
MP-14-8.5	0.26	0.18	0.14	0.23
MP-15-10	--	--	--	0.13

MONITORING POINT W/DEPTH	OXYGEN LEVEL (O_2 %)			
	1/98 THROUGH 4/98		5/98	6/98
MP-1-3	NO SOIL GAS SAMPLES COLLECTED DUE TO WINTER CONDITIONS		WATER	WATER
MP-1-6			16.8	14.2
MP-1-10			NF	17.8
MP-2-3			WATER	9.3
MP-2-6			NF	5.9
MP-2-10			19.9	18.9
MP-3-3			NF	NF
MP-3-6			NF	12.5
MP-3-10			19.6	19.6
MP-4BG-4.4			11.7	10.8
MP-5-3			WATER	13.9
MP-5-6			WATER	NF
MP-6-3			20.7	20.9
MP-6-10			20.2	20.4
MP-7-3			WATER	18.7
MP-7-6			NF	19.4
MP-8-3			WATER	19.0
MP-8-6			NF	20.9
MP-9-3			WATER	3.7
MP-9-10			19.6	18.0
MP-10-3			13.1	10.5
MP-10-6			WATER	NF
MP-11-3			20.0	15.1
MP-11-6			20.1	18.9
MP-11-10			20.6	19.3
MP-12-3			NF	NF
MP-12-6			19.1	17.1
MP-12-10			19.5	NF
MP-13-3			NF	NF
MP-13-6			NF	7.7
MP-13-10			NF	NF
MP-14-3			WATER	NF
MP-14-6			WATER	10.6
MP-14-8.5			19.5	16.9
MP-15-3			NF	1.3
MP-15-6			WATER	WATER
MP-15-10			NF	17.9
MP-16-8.5	M	21.0 20.9 M	M	M

22784/043/FIG3-12.DGN

Figure 8-1
FTA Biovent System Layout and Average Wellhead Flow

Table 8 - 1 FTA Air Flow and Monitoring Point Data

Air Injection Well	Screen Interval ft/bgs top	bottom	Overburden Pressure[1] (psi)	Design Air Flow (scfm)	Individual Well Head Flow (scfm) January 1998	February 1998	March 1998	April 1998	May 1998	June 1998	Average Jan - Jun
AIW-1	6.9	11.8	4.8	3	1	1	1	0	0	1.2	0.7
AIW-2	6.4	11.3	4.4	3	0	0	0	0	0	0	0.0
AIW-3	6.9	11.8	4.8	3	3	3	3	3	3	3	3.0
AIW-4	6.1	11.1	4.2	3	3	3	3	2	3	3	2.8
AIW-5	7.4	12.3	5.1	3	3	3	3	0	3	3	2.5
AIW-6	7.2	12.1	5.0	3	3	3	3	3	3	3	3.0
AIW-7	6.4	11.3	4.4	3	3	3	0	3	3	3	2.5
AIW-8	6.9	11.8	4.8	3	3	3	3	3	3	3	3.0
AIW-9	4.1	9	2.8	3	3	3	3	3	3	3	3.0
AIW-10	4.9	9.8	3.4	3	3	3	2	3	3	3	2.8
AIW-11	3.9	8.8	2.7	3	3	3	3	3	3	3	3.0
AIW-12	4.6	9.5	3.2	3	1.4	1.5	2	1.5	1.2	1.5	1.5
AIW-13	2.8	8.8	1.9	3	3	3	3	3	off	2.2	2.8
AIW-14	4.4	9.3	3.1	3	0.5	0.8	1.2	0	0	0	0.4
AIW-15	7.4	12.3	5.1	3	3	3	3	3	3	3	3.0
AIW-16	4.9	9.8	3.4	3	1.1	1	1.4	1	1	1	1.1
Total air flow:				48	37.0	37.3	34.6	31.5	32.2	35.9	
Pressure (psi):					3.7	3.7	4.2	2	2.5	3.8	

Monitoring Point	Screen Interval (ft bgs) top	bottom		Soil Gas Sampling Results January 1998 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	February 1998 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	March 1998 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	April 1998 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	May 1998 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	June 1998 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)
MP-1-3	3	3.5		No Soil Gas			No Soil Gas			No Soil Gas			No Soil Gas				water			water	
MP-1-6	6	6.5	O_2 Util. Rate = 0.19%/hr[3]	Samples Collected			Samples Collected			Samples Collected			Samples Collected			16.8	3.4	283	14.2	3.8	318
MP-1-10	10	10.5		due to Winter Conditions			due to Winter Conditions			due to Winter Conditions			due to Winter Conditions				no flow		17.8	1.1	501
MP-2-3	3	3.5	O_2 Util. Rate = 0.88%/hr[3]														water		9.3	2.4	flame out
MP-2-6	6	6.5															no flow		5.9	0.0	flame out
MP-2-10	10	10.5														19.9	0.4	38.6	18.9	0.3	13.2
MP-3-3	3	3.5															no flow			no flow	
MP-3-6	6	6.5	O_2 Util. Rate = 0.21%/hr[3]														no flow		12.5	1.4	81
MP-3-10	10	10.5														19.6	0.5	25.4	19.6	0.6	7.6
MP-4BG-4.4	4.4	10	O_2 Util. Rate = 0.30%/hr[3]													11.7	2.0	1.8	10.8	2.5	flame out
MP-5-3	3	3.5	O_2 Util. Rate = 0.30%/hr[3]														water		13.9	9.4	8127
MP-5-6	6	6.5															water			no flow	
MP-6-3	3	3.5														20.7	0.0	1.3	20.9	0.0	0
MP-6-10	10	10.5														20.2	0.1	0.8	20.4	0.2	0
MP-7-3	3	3.5															water		18.7	2.4	1.5
MP-7-6	6	6.5															no flow		19.4	0.7	6.4
MP-8-3	3	3.5															water		19.0	0.5	28
MP-8-6	6	6.5															no flow		20.9	0.0	4.3
MP-9-3	3	3.5	O_2 Util. Rate = 1.54%/hr[3]														water		3.7	13.7	flame out
MP-9-10	10	10.5	O_2 Util. Rate = 0.10%/hr[3]													19.6	0.9	478	18.0	1.4	1020
MP-10-3	3	3.5	O_2 Util. Rate = 0.39%/hr[3]													13.1	6.5	295	10.5	9.8	flame out
MP-10-6	6	6.5															water			no flow	
MP-11-3	3	3.5	O_2 Util. Rate = 0.42%/hr[3]													20.0	0.5	21.7	15.1	2.0	9.6
MP-11-6	6	6.5														20.1	0.4	4.1	18.9	0.3	6.5
MP-11-10	10	10.5														20.6	0.2	3.9	19.3	0.0	14
MP-12-3	3	3.5															no flow			no flow	
MP-12-6	6	6.5	O_2 Util. Rate = 0.09%/hr[3]													19.1	1.3	13.2	17.1	1.9	28
MP-12-10	8.5	9														19.5	0.8	11.3		no flow	
MP-13-3	3	3.5															no flow			no flow	
MP-13-6	6	6.5	O_2 Util. Rate = 0.1%/hr[3]														no flow		7.7	8.0	flame out
MP-13-10	7	7.5															no flow			no flow	
MP-14-3	3	3.5															water			no flow	
MP-14-6	6	6.5															water		10.6	4.9	flame out
MP-14-8.5	8.5	9	O_2 Util. Rate = 0.23%/hr[3]													19.5	0.7	53.3	16.9	1.1	34
MP-15-3	3	3.5															no flow		1.3	15.9	flame out
MP-15-6	6	6.5															water			water	
MP-15-10	9	9.5	O_2 Util. Rate = 0.13%/hr[3]														no flow		17.9	0.9	233
MP-16-8.5	8.5	9	O_2 sensor	malf	na	na	21.0	na	na	20.9	na	na	malf	na	na	malf	na	na	malf	na	na

[1] Maximum pressure before potential for fracturing of soil. Calculated at top of screen assuming density of soil is 100 lbs/ft^3.

[2] The monthly O_2 sensor results is the average for month. See biovent monthly reports for daily values.

[3] Test performed on 6/29/98 and 6/30/98.

malf = malfunctioned, no data, nr = no reading.

NOTE: AIW's that are noted to be "off" have been shutdown due to well seal leaks.

NOTE: Flame out occurs due to low oxygen levels.

Table 8-2 FTA Groundwater Level Data

Fire Training Area Groundwater Levels from January through June 1998

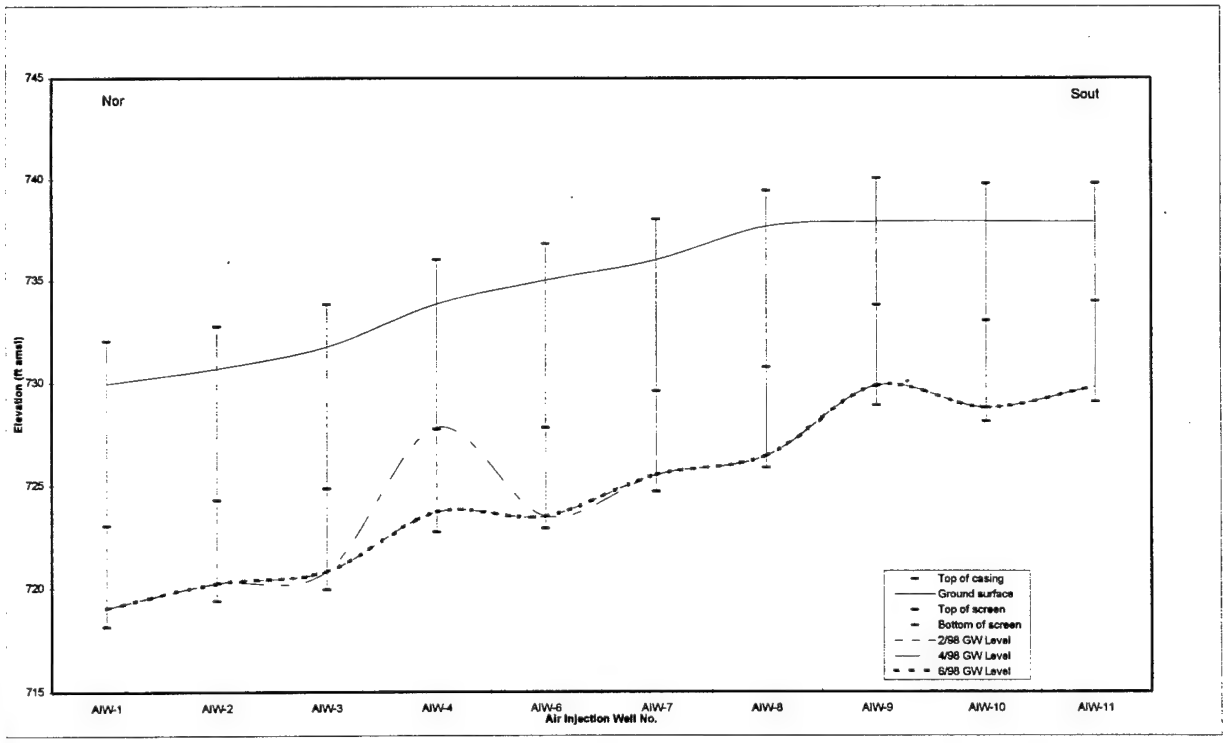
Well No.	Well Depth below TOC	Top of Screen below TOC	Jan-98	Feb-98	Mar-98	Apr-98	May-98	Jun-98
AIW-1	14.1	9.0	13	13	13	13	13	13
AIW-2	13.6	8.5	12.5	12.5	12.5	12.5	12.5	12.5
AIW-3	14.1	9.0	13	13	13	13	13	13
AIW-4	13.5	8.3	12.3	12.3	12.3	**8.2**	12.3	12.3
AIW-5	14.2	9.1	13.5	13.5	13.5	13.5	13.5	13.5
AIW-6	14.1	9.0	13.3	13.3	13.3	13.3	13.3	13.3
AIW-7	13.5	8.4	12.5	12.5	12.5	12.5	12.5	12.5
AIW-8	13.8	8.7	13	13	13	13	13	13
AIW-9	11.4	6.3	10.2	10.2	10.2	10.2	10	10.2
AIW-10	11.9	6.8	11	11	11	11	11	11
AIW-11	10.9	5.8	10	10	10	10	10	10
AIW-12	11.5	6.4	10.7	10.7	10.7	10.7	10.7	10.7
AIW-13	10.6	4.4	10	10	10	10	10	10
AIW-14	11.4	6.3	10.5	10.5	10.5	10.5	10.5	10.5
AIW-15	14.3	9.2	13.5	13.5	13.5	13.5	13.5	13.5
AIW-16	12.0	6.9	11	11	11	11	11	11

Bolded value: indicates water level is at or above the top of the screen.

Groundwater Levels along North / South Transect at Fire Training Area (see Figure 8-1 for transect location)

Well No.	Elevation at top of casing (ft amsl)	Elevation of ground surface	Elevation of water - FEB. (ft amsl)	Elevation of water - APR. (ft amsl)	Elevation of water - JUN. (ft amsl)	Depth to top of screen (ft)	Elevation to TOS (ft amsl)	Depth to bottom of screen (ft)	Elevation to BOS (ft amsl)
AIW-1	732.05	729.96	719.05	719.05	719.05	9.0	723.06	13.9	718.16
AIW-2	732.75	730.69	720.25	720.25	720.25	8.5	724.29	13.4	719.39
AIW-3	733.83	731.75	720.83	720.83	720.83	9.0	724.85	13.9	719.95
AIW-4	736.02	733.85	723.72	727.82	723.72	8.3	727.75	13.3	722.75
AIW-6	736.82	735.02	723.52	723.52	723.52	9.0	727.82	13.9	722.92
AIW-7	738.04	736.01	725.54	725.54	725.54	8.4	729.61	13.3	724.71
AIW-8	739.45	737.67	726.45	726.45	726.45	8.7	730.77	13.6	725.87
AIW-9	740.07	737.90	729.87	729.87	729.87	6.3	733.80	11.2	728.90
AIW-10	739.79	737.93	728.79	728.79	728.79	6.8	733.03	11.7	728.13
AIW-11	739.82	737.88	729.82	729.82	729.82	5.8	733.98	10.7	729.08

North / South Cross Section at Fire Training Area



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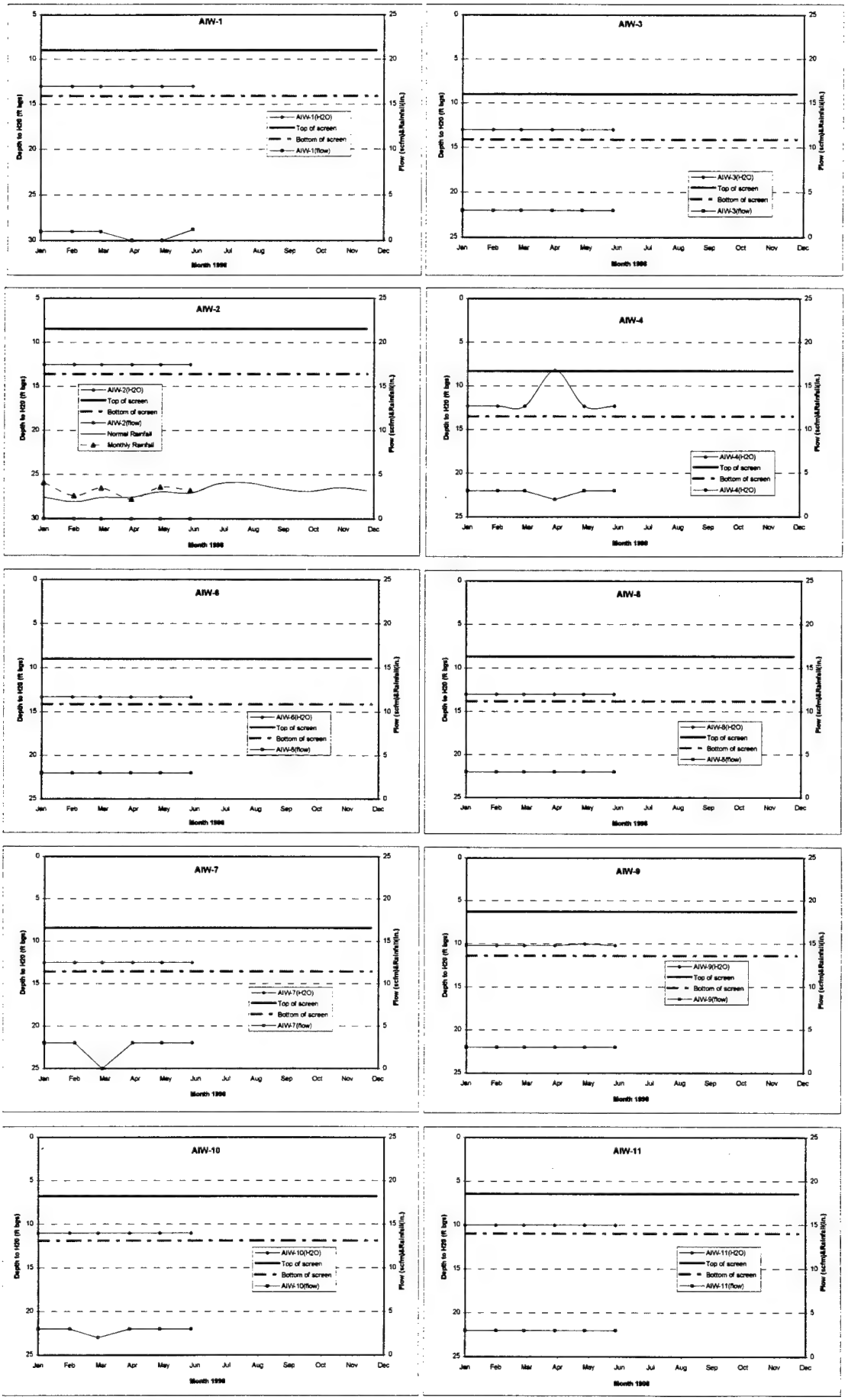


See Figure 8-1 for transect location.

Figure 8-2 FTA Groundwater/Air Flow Relations Along North/South Section

Gw_flow2.xls

9.0 FUEL TANK FARM BIOVENT/BIOSLURP

9.1 OPERATIONS

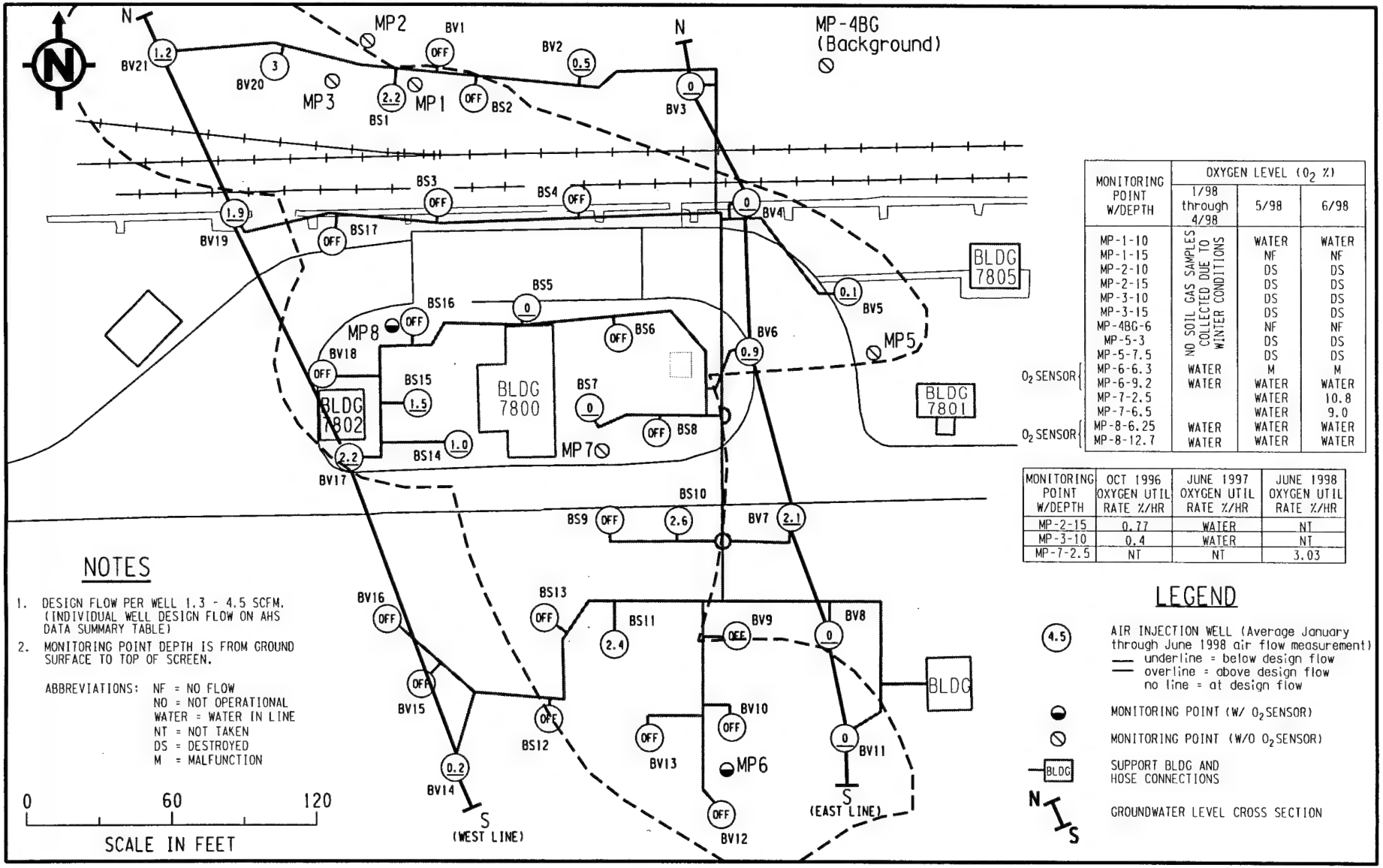
The FTF bioslurp/biovent system installed at OU 11 is made up of 17 bioslurp wells, 21 biovent wells, and 1 single-elevation and 7 dual-elevation MPs (15 MPs); 4 of the dual-elevation MPs have oxygen sensors (Figure 9-1). The FTF system ran from August 16 to August 23 1997 in the bioslurp mode; however, did not run in bioslurp mode during the first half of 1998. When Depot Roads completed work late in November and the system was changed back to the bioventing mode for winter operation, damage to the PLC boards in the control system was discovered. The cause for the damage could not be determined, but moisture leakage into the control panel was suspected. The system was repaired and operation resumed in January 1998, at which time was started up in the bioventing mode. Since BEI assumed responsibility for the bioventing O&M shortly after installation in November 1996, the system had operated in bioventing mode 344 days through June 30, 1998.

9.2 CONCLUSIONS AND RECOMMENDATIONS

BV-4 continues to contain groundwater above the top of the screen resulting in zero air flow into the well. During April and May, the total air flow into the online AIWs was extremely low (9.1 and 3.7 scfm, respectively). The design total flow rate is 55.6 scfm (Table 9-1). Pressure to the system was essentially held constant between 2 and 2.9 psi. More than half the wells (11 of 20) did not accept air in April versus only 2 wells accepting air in May. Leaking well seals resulted in shutting down two AIWs in April, five in May, and two in June (indicated as "off" in Table 9-1). It appears that higher water levels during April through June have had a pronounced effect on the air flow (Table 9-2 and Figure 9-2).

Several of the MPs (6 out of 11) were destroyed during the 1997 Depot Roads remediation work. Only one of the remaining five functioning MPs produced data (MP-7, during June). MP-7 indicates that contaminants exist in this area. A respiration test was performed at this MP in June. An oxygen utilization rate of approximately 3 percent/hour was calculated, although this rate is based on minimal data (only three measurements) and minimal air flow from this MP. The high CO_2 levels and flameout conditions also indicate contamination is likely present. The four oxygen sensors were inundated with water during the entire 6-month reporting period.

Overall Recommendation for FTF: Change to bioslurp mode as soon as groundwater levels begin to stabilize. Collect groundwater levels monthly at a minimum and biweekly if possible to establish pattern and cycle. Install up to nine new AIWs where needed throughout the FTF II area. In addition, move up to four existing oxygen sensors to new locations.



MONITORING POINT W/DEPTH	OXYGEN LEVEL (O_2 %) 1/98 through 4/98	5/98	6/98
MP-1-10	NO SOIL GAS SAMPLES COLLECTED DUE TO WINTER CONDITIONS	WATER	WATER
MP-1-15		NF	NF
MP-2-10		DS	DS
MP-2-15		DS	DS
MP-3-10		DS	DS
MP-3-15		DS	DS
MP-4BG-6		NF	NF
MP-5-3		DS	DS
MP-5-7.5		DS	DS
MP-6-6.3	WATER	M	M
O_2 SENSOR MP-6-9.2	WATER	WATER	WATER
MP-7-2.5		WATER	10.8
MP-7-6.5		WATER	9.0
O_2 SENSOR MP-8-6.25	WATER	WATER	WATER
MP-8-12.7	WATER	WATER	WATER

MONITORING POINT W/DEPTH	OCT 1996 OXYGEN UTIL RATE %/HR	JUNE 1997 OXYGEN UTIL RATE %/HR	JUNE 1998 OXYGEN UTIL RATE %/HR
MP-2-15	0.77	WATER	NT
MP-3-10	0.4	WATER	NT
MP-7-2.5	NT	NT	3.03

NOTES

1. DESIGN FLOW PER WELL 1.3 - 4.5 SCFM. (INDIVIDUAL WELL DESIGN FLOW ON AHS DATA SUMMARY TABLE)
2. MONITORING POINT DEPTH IS FROM GROUND SURFACE TO TOP OF SCREEN.

ABBREVIATIONS:
NF = NO FLOW
NO = NOT OPERATIONAL
WATER = WATER IN LINE
NT = NOT TAKEN
DS = DESTROYED
M = MALFUNCTION

LEGEND

- (4.5) AIR INJECTION WELL (Average January through June 1998 air flow measurement)
  - underline = below design flow
  - overline = above design flow
  - no line = at design flow
- MONITORING POINT (W/ O_2 SENSOR)
- MONITORING POINT (W/O O_2 SENSOR)
- BLDG SUPPORT BLDG AND HOSE CONNECTIONS
- N S GROUNDWATER LEVEL CROSS SECTION

22784/043/FIG3-16.DGN

Figure 9-1
FTF Biovent System Layout and Average Wellhead Flow

Table 9-1 FTF Air Flow and Monitoring Point Data

Air Injection Well [1]	Screen Interval ft/bgs top	bottom	Overburden Pressure[2] (psi)	Design Air Flow (scfm)	Individual Well Head Flow (scfm) January 1998	February 1998	March 1998	April 1998	May 1998	June 1998	Average Jan - Jun
BV-2	13	20	9.0	3	1	1.8	0	0	0	0	0.5
BV-3	13	18	9.0	3	0	0	0	0	0	0	0.0
BV-4	12	19	8.3	2.7	0	0	0	0	0	0	0.0
BV-5	12	19	8.3	2.7	0	0.8	0	0	0	0	0.1
BV-6	5	13	3.5	3.7	0	0	0	0	2.6	3	0.9
BV-7	6	16	4.2	3.4	3.4	3.4	1.5	1	1.1	1.9	2.1
BV-8	6	16	4.2	2.2	0	0	0	0	0	0	0.0
BV-11	7	14	4.9	1.6	0	0	0	off	off	off	0.0
BV-14	7	14	4.9	1.6	0	0	0	1	0	0	0.2
BV-17	6	16	4.2	3.4	3.4	3.4	2	0	off	off	2.2
BV-19	11	19	7.6	2.7	2.7	2.7	2.7	1.3	0	2.2	1.9
BV-20	13	20	9.0	3	3	3	3	off	off	3	3.0
BV-21	15	20	10.4	1.6	1.6	1.6	1.6	0.8	0	1.6	1.2
BS-1	13	20	9.0	3	3	3	3	1.4	0	3	2.2
BS-5	11	18	7.6	3	0	0	0	0	0	0	0.0
BS-7	9	16	6.3	3	0	0	0	0	0	0	0.0
BS-10	6	16	4.2	3	3	3	3	1.9	off	2.2	2.6
BS-11	5.5	15.5	3.8	3	3	3	1.6	1.7	off	2.6	2.4
BS-14	9	16	6.3	3	3	3	0	0	0	0	1.0
BS-15	11	18	7.6	3	3	3	3	0	0	0	1.5
Total air flow:				55.6	30.1	31.7	21.4	9.1	3.7	19.5	
Pressure (psi):					2.9	2.9	2.6	2	2.4	2.7	

Monitoring Point	Screen Interval (ft bgs) top	bottom		Soil Gas Sampling Results January 1998 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	February 1998 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	March 1998 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	April 1998 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	May 1998 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	June 1998 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)
MP-1-10	10	10.5		No Soil Gas			No Soil Gas			No Soil Gas			No Soil Gas			water			water		
MP-1-15	15	15.5		Samples Collected			Samples Collected			Samples Collected			Samples Collected			no flow			no flow		
MP-2-10	10	10.5		due to Winter Conditions			due to Winter Conditions			due to Winter Conditions			due to Winter Conditions			destroyed			destroyed		
MP-2-15	15	15.5														destroyed			destroyed		
MP-3-10	10	10.5														destroyed			destroyed		
MP-3-15	15	15.5														destroyed			destroyed		
MP-4BG-6	6	11	Background location													no flow			no flow		
MP-5-3	3	3.5														destroyed			destroyed		
MP 5-7.5	7.5	8														destroyed			destroyed		
MP-6-6.3	6.3	6.8	O_2 Sensor	Water covering sensor			Water covering sensor			Water covering sensor			Water covering sensor			Malfunction			Malfunction		
MP-6-9.2	9.2	9.7	O_2 Sensor	Water covering sensor			Water covering sensor			Water covering sensor			Water covering sensor			Water covering sensor			Water covering sensor		
MP-7-2.5	2.5	3	O_2 Util. Rate = 3.03%/hr[3]													water			10.8	10.2	flame out
MP-7-6.5	6.5	7														water			9.0	4.3	flame out
MP-8-6.25	6.25	6.75	O_2 Sensor	Water covering sensor			Water covering sensor			Water covering sensor			Water covering sensor			Water covering sensor			Water covering sensor		
MP-8-12.7	12.7	13.2	O_2 Sensor	Water covering sensor			Water covering sensor			Water covering sensor			Water covering sensor			Water covering sensor			Water covering sensor		

[1] All wells are in a bioventing mode (BV = biovent & BS = bioslurp).

[2] Maximum pressure before potential for fracturing of soil. Calculated at top of screen assuming density of soil is 100 lbs/ft^3.

[3] Test performed on 6/29/98.

NOTE: AIW's that are noted to be "off" have been shutdown due to well seal leaks.

NOTE: Flame out occurs due to low oxygen levels.

Fuel Tank Farm Well Water Levels from January through June 1998

Well No.	Well Depth below TOC	Top of Screen below TOC	Jan-98	Feb-98	Mar-98	Apr-98 (note 1)	May-98	Jun-98
BV-2	20	13	18.5	20	17.2	20.05	13.4	19.5
BV-3	18	13	17.9	18	18	18	18	19.35
BV-4	19	12	**8.8**	**8.4**	**7.3**	**5.3**	**5.8**	**7.7**
BV-5	19	12	19.6	19	19.7	17.3	12.1	17.3
BV-6	13	5	**2.9**	13	nt	4	6.9	6.9
BV-7	16	8	10.1	11.5	10	8	9.2	10.35
BV-8	16	8	16.3	16.5	14.8	13.7	9.6	13.35
BV-11	14	7	6.9	7.2	7.6	7.5	**2.8**	**2.5**
BV-14	14	7	13.1	12.8	13.4	12.8	9.43	13.35
BV-17	16	6	6.4	16	**5.2**	**3.9**	**4.2**	5.1
BV-19	19	11	19	19	19	16.4	14.75	16.8
BV-20	20	13	20	20	20	20.6	17.65	20
BV-21	20	15	20	20	20	20	20	20
BS-1	20	13	20	20	20	18.8	16.8	20.2
BS-5	18	13	18.7	18	18	18	14.45	18
BS-7	16	9	10.6	12.8	14.5	14.9	13.75	11.65
BS-10	16	6	7.5	9.5	7.7	9.6	**3.83**	7.5
BS-11	15.5	5.5	11.5	12.9	10	6.7	**3.51**	12.1
BS-14	16	9	11.8	11.3	**8.8**	**6.45**	**8.9**	**6.4**
BS-15	18	11	19.5	19.6	16.2	16.7	14.6	18.25

Note 1: The depth to water at BV-6 in April 1998 was not taken. The value 4 ft was used because a number is needed for the graph. No number is assumed to be zero in excel.

Bolded value: indicates water level is at or above the top of the screen.

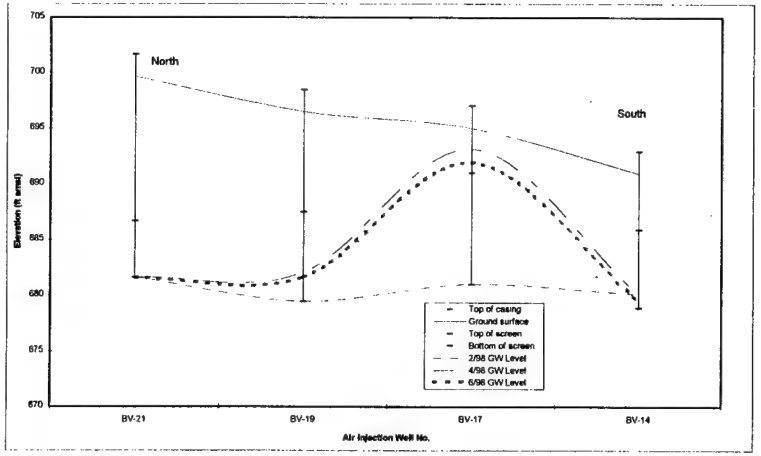
Groundwater Levels along North / South (Westline) Transect at FTF (see Figure 9-1 for transect)

Well No.	Elevation at top of casing (ft amsl)	Approx ground elev (2 < TOC)	Elevation of water - FEB. (ft amsl)	Elevation of water - APR. (ft amsl)	Elevation of water - JUN. (ft amsl)	Depth to top of screen (ft)	Elevation to TOS (ft amsl)	Depth to bottom of screen (ft)	Elevation to BOS (ft amsl)
BV-21	701.65	699.65	681.65	681.65	681.65	15	686.65	20	681.65
BV-19	698.48	696.48	679.48	682.08	681.68	11	687.48	19	679.48
BV-17	697	695	681	693.1	691.9	6	691	16	681
BV-14	692.91	690.91	680.11	680.11	679.56	7	685.91	14	678.91

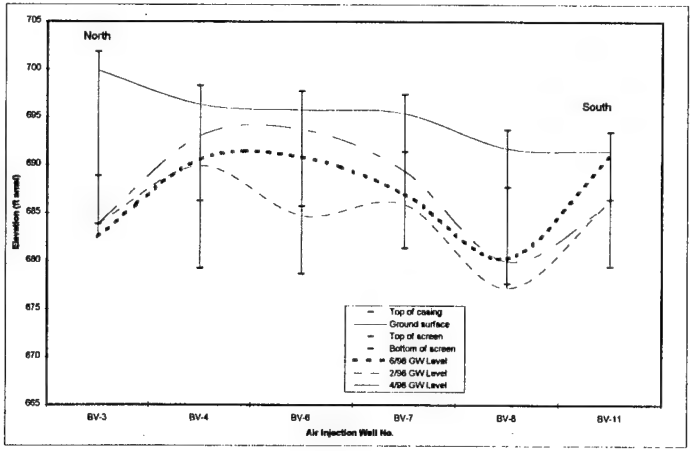
Groundwater Levels along North / South (Eastline) Transect at FTF (see Figure 9-1 for transect)

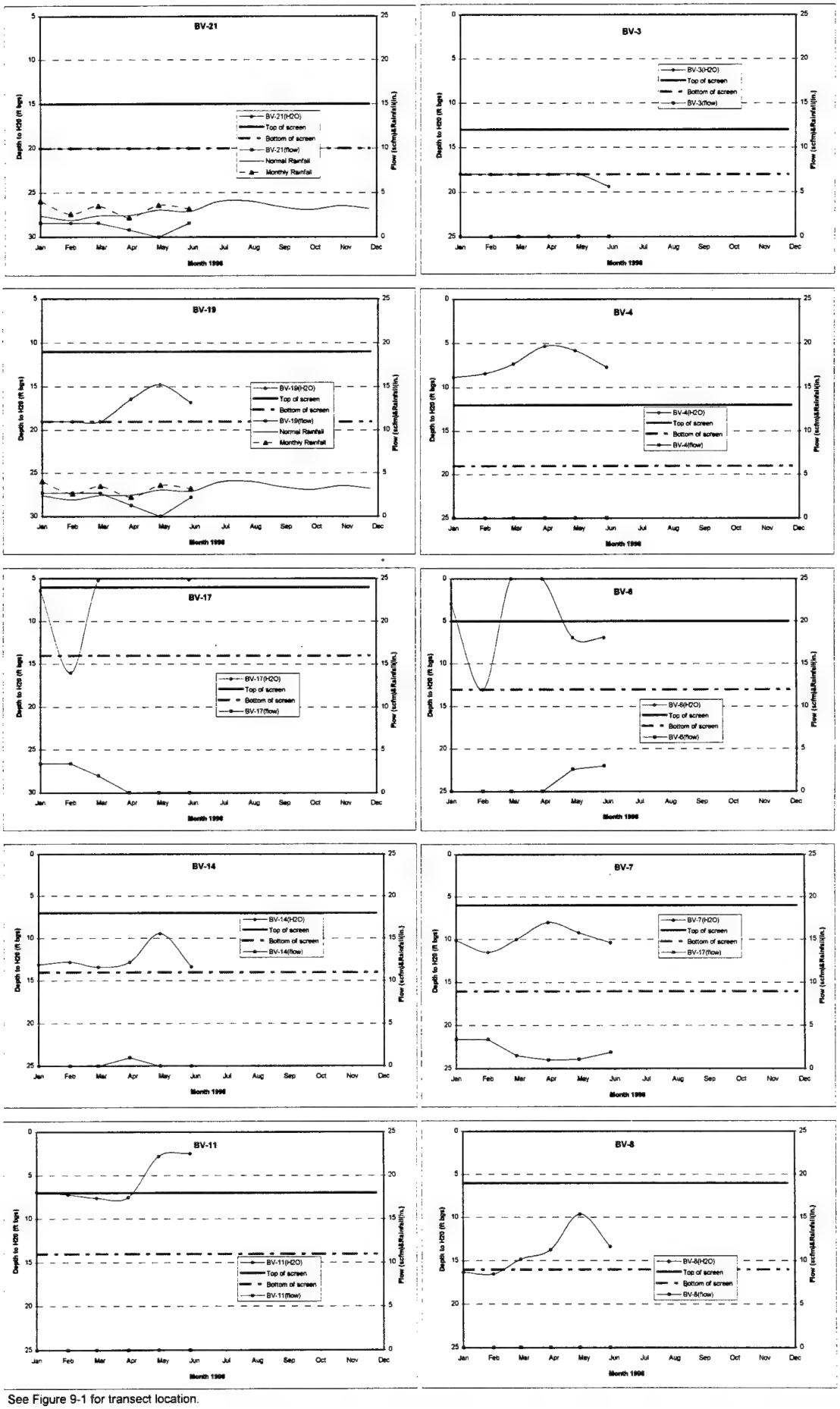
Well No.	Elevation at top of casing (ft amsl)	Elevation of ground (ft amsl)	Elevation of water - FEB. (ft amsl)	Elevation of water - APR. (ft amsl)	Elevation of water - JUN. (ft amsl)	Depth to top of screen (ft)	Elevation to TOS (ft amsl)	Depth to bottom of screen (ft)	Elevation to BOS (ft amsl)
BV-3	701.86	699.86	683.86	683.86	682.51	13	688.86	18.0	683.86
BV-4	698.30	696.3	688.90	693.00	690.60	12	686.3	19.0	679.3
BV-6	697.72	695.72	684.72	693.72	690.82	12	685.72	19.0	678.72
BV-7	697.38	695.38	685.88	689.38	687.03	8	691.38	16.0	681.38
BV-8	693.71	691.71	677.21	680.01	680.36	8	687.71	16.0	677.71
BV-11	693.47	691.47	686.27	685.97	690.97	7	686.47	14.0	679.47

North / South Cross Section at FTF - Westline



North / South Cross Section at FTF - Eastline





See Figure 9-1 for transect location.

Figure 9-2 FTF Groundwater/Air Flow Relations Along North/South Section of East and West Lines

10.0 FUEL TANK FARM II

10.1 OPERATIONS

The FTF II, located in OU 11, consists of 37 AIWs and 24 MPs (6 with oxygen sensors) (Figure 10-1). BEI installed the FTA biovent system in the summer of 1997 and started operation on August 28, 1997. BEI assumed responsibility for the bioventing O&M in October 1997. The system operated until September 20, when it was shut down due to construction activities by Depot Roads, a subcontractor to COE. The system was restarted on October 31, 1997 and has run continuously since that time. Through June 30, 1998 the system has operated for a total of 253 days.

The number of AIWs accepting air steadily increased from 2 at startup in September to 24 in December. Since then, the number of functioning AIWs has decreased dramatically. Injection flow rates in wells accepting air are typically near the design flow rate of 3 scfm (Table 10-1). The overall system injection pressure was held between 2.4 and 3.3 psi throughout the reporting period.

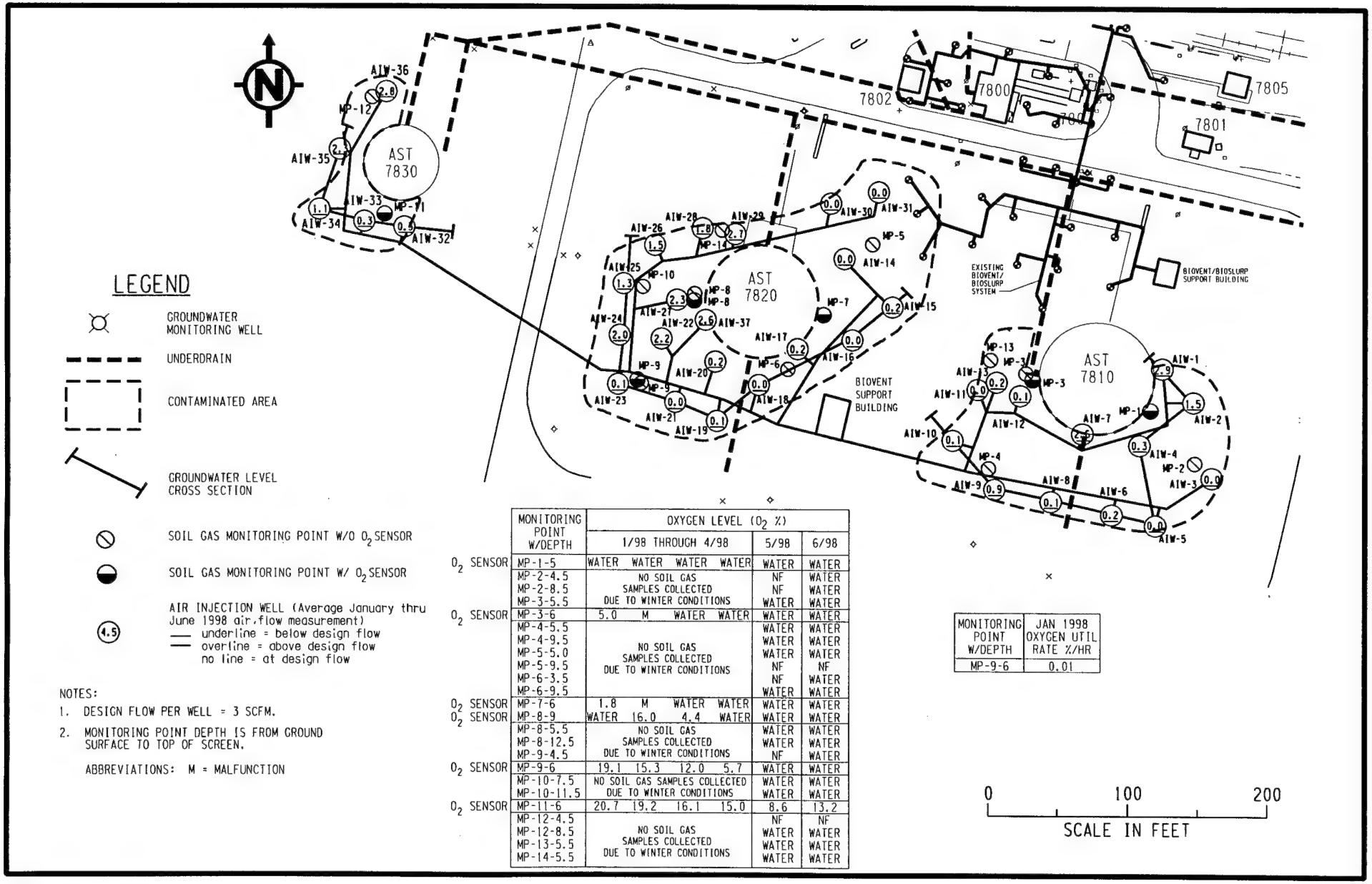
10.2 CONCLUSIONS AND RECOMMENDATIONS

Table 10-2 presents groundwater levels in AIWs and cross-sectional views of the generalized water table. Water tables were elevated from April through June resulting in AIW water levels to cover more than half the screened interval in a majority of wells. Figures 10-2 through 10-4 present the January through June groundwater levels and air flows per AIW located along the cross sections on Figure 10-1. Initially, low groundwater levels were typical, but a general increase in the water level is noted during the spring and early summer months. As the water table drops, air flow typically increases. The average and normal monthly rainfall curve has been added to the AIW graphs for comparison to groundwater levels.

The oxygen sensors worked well during the winter months, but high water has inundated these locations also. Five of the 6 oxygen sensors produced data during one or more months within the reporting period (see Table 10-1). Oxygen levels ranged from a low 1.8 to a high of 20.7 percent during the reporting period. No MPs could be sampled during May and June due to no flow or high water. Winter conditions prevented sampling during January through April. As on all biovent sites, only oxygen sensor data could be collected during winter months because standard MPs are inaccessible.

One respiration tests was run in January where the oxygen level was initially around 18 percent. The test result of 0.01 percent oxygen/hour was typical of background levels (Figure A-18). The oxygen level did get down to near 14 percent by the end of the respiration test. A lower oxygen level (5.7 percent) was noted during operations in April. Respiration tests could not be run in June because all but one of the MPs were inundated with water or fuel. Fuel was noted in MP-8-5, MP-9-4, MP-10-7, and MP-11. Fuel was not visible but odor was noted in 7 intervals within 5 MPs (MP-2, -4, -6, -8, and -13).

Overall Recommendation for FTF II: No changes to the system are recommended because it has not been running for any length of time within ideal conditions (i.e., low saturation levels).



	MONITORING POINT W/DEPTH	OXYGEN LEVEL (O_2 %) 1/98 THROUGH 4/98	5/98	6/98
O_2 SENSOR	MP-1-5	WATER WATER WATER WATER	WATER	WATER
	MP-2-4.5	NO SOIL GAS SAMPLES COLLECTED DUE TO WINTER CONDITIONS	NF	WATER
	MP-2-8.5		NF	WATER
	MP-3-5.5		WATER	WATER
O_2 SENSOR	MP-3-6	5.0 M WATER WATER	WATER	WATER
	MP-4-5.5	NO SOIL GAS SAMPLES COLLECTED DUE TO WINTER CONDITIONS	WATER	WATER
	MP-4-9.5		WATER	WATER
	MP-5-5.0		WATER	WATER
	MP-5-9.5		NF	NF
	MP-6-3.5		NF	WATER
	MP-6-9.5		WATER	WATER
O_2 SENSOR	MP-7-6	1.8 M WATER WATER	WATER	WATER
O_2 SENSOR	MP-8-9	WATER 16.0 4.4 WATER	WATER	WATER
	MP-8-5.5	NO SOIL GAS SAMPLES COLLECTED DUE TO WINTER CONDITIONS	WATER	WATER
	MP-8-12.5		WATER	WATER
	MP-9-4.5		NF	WATER
O_2 SENSOR	MP-9-6	19.1 15.3 12.0 5.7	WATER	WATER
	MP-10-7.5	NO SOIL GAS SAMPLES COLLECTED DUE TO WINTER CONDITIONS	WATER	WATER
	MP-10-11.5		WATER	WATER
O_2 SENSOR	MP-11-6	20.7 19.2 16.1 15.0	8.6	13.2
	MP-12-4.5	NO SOIL GAS SAMPLES COLLECTED DUE TO WINTER CONDITIONS	NF	NF
	MP-12-8.5		WATER	WATER
	MP-13-5.5		WATER	WATER
	MP-14-5.5		WATER	WATER

MONITORING POINT W/DEPTH	JAN 1998 OXYGEN UTIL RATE %/HR
MP-9-6	0.01

22784/043/FIG10-1A.DGN

Figure 10-1
FTF II Biovent System Layout and Average Wellhead Flow

Table 10-1 FTF II Air F[illegible]nd Monitoring Point Data

Air Injection Well	Screen Interval ft/bgs top	bottom	Overburden Pressure[1] (psi)	Design Air Flow (scfm)	Individual Well Head Flow (scfm) January 1998	February 1998	March 1998	April 1998	May 1998	June 1998	Average Jan - Jun
AIW-1	5.9	15.7	4.1	3	3	3	2.9	2.75	3	2.7	2.9
AIW-2	6.5	16.3	4.5	3	0	3	2.9	off	off	0	1.5
AIW-3	6.6	16.3	4.6	3	0	0	0	0	0	0	0.0
AIW-4	6.4	16.2	4.4	3	0	1.1	0	off	off	0	0.3
AIW-5	6.5	16.2	4.5	3	0	0	0	0	0	0	0.0
AIW-6	6.5	16.2	4.5	3	0	0	0	0	1	0	0.2
AIW-7	6.3	16.3	4.4	3	3	3	2.9	2	3	3	2.8
AIW-8	6.5	16.3	4.5	3	0	0	0	0	0	0.5	0.1
AIW-9	6.5	16.2	4.5	3	2	1.3	1.1	0	0	0.7	0.9
AIW-10	6.6	16.3	4.6	3	0	0.8	0	0	0	0	0.1
AIW-11	6.9	16.7	4.8	3	0	0	0	0	off	0	0.0
AIW-12	6.8	16.5	4.7	3	0	0	0	0	0.5	0	0.1
AIW-13	6.7	16.4	4.7	3	0	0	0	0	1	0	0.2
AIW-14	6.5	16.2	4.5	3	0	0	0	0	0	0	0.0
AIW-15	6.6	16.3	4.6	3	0	0	1	0	off	0	0.2
AIW-16	6.5	16.2	4.5	3	0	0	0	0	0	0	0.0
AIW-17	6.6	16.7	4.6	3	0	1.1	0	0	0	0	0.2
AIW-18	6.5	16.3	4.5	3	0	0	0	0	0	0	0.0
AIW-19	6.6	16.3	4.6	3	0	0	0.5	0	0	0	0.1
AIW-20	6.5	16.2	4.5	3	0	0.5	0.5	0	0	0	0.2
AIW-21	6.6	16.3	4.6	3	0	0	0	off	off	0	0.0
AIW-22	6.6	16.3	4.6	3	3	3	off	off	off	0.5	2.2
AIW-23	6.5	16.3	4.5	3	0	0	0	0.5	0	0	0.1
AIW-24	6.6	16.3	4.6	3	3	3	off	2	off	0	2.0
AIW-25	6.5	16.3	4.5	3	3	3	1.7	0	0	0	1.3
AIW-26	6.6	16.3	4.6	3	3	3	3	0	0	0	1.5
AIW-27	6.6	16.3	4.6	3	3	3	3	off	off	0	2.3
AIW-28	6.6	16.3	4.6	3	3	3	3	0	oiff	0	1.8
AIW-29	6.6	16.4	4.6	3	3	3	2.9	3	1.8	2.5	2.7
AIW-30	6.6	16.3	4.6	3	0	0	off	0	off	0	0.0
AIW-31	6.5	16.2	4.5	3	0	0	0	0	0	0	0.0
AIW-32	6.5	16.3	4.5	3	1	0.5	0	0	off	0	0.3
AIW-33	6.3	16.3	4.4	3	1	0	0	1	0	0	0.3
AIW-34	6.5	16.5	4.5	3	1.4	1.2	1.1	1.5	1	0.5	1.1
AIW-35	6.4	16.7	4.4	3	3	3	3	off	off	0	2.3
AIW-36	6.4	16.5	4.4	3	3	3	3	off	off	2	2.8
AIW-37	6.6	16.3	4.6	3	3	3	2	2	2.6	2.8	2.6
Total air flow:				111	41.4	45.5	34.5	14.8	13.9	15.2	
Pressure (psi):					3	2.8	3.3	2.4	2.9	2.9	

Monitoring Point	Screen Interval top	bottom		Soil Gas Sampling Results January 1998 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	February 1998 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	March 1998 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	April 1998 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	May 1998 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	June 1998 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)
MP-1-5	5	5.5	O_2 Sensor	water	na	na	water	na	na	water	na	na	water	na	na	Water covering sensor			Water covering sensor		
MP-2-4.5	4.5	5														no flow			water		
MP-2-8.5	8.5	9														no flow			water		
MP-3-5.5	5.5	6														water			water		
MP-3-6	6	6.5	O_2 Sensor	5.0	na	na	malf	na	na	water	na	na	water	na	na	Water covering sensor			Water covering sensor		
MP-4-5.5	5.5	6														water			water		
MP-4-9.5	9.5	10		No Soil Gas			No Soil Gas			No Soil Gas			No Soil Gas			water			water		
MP-5-5.0	5.5	6		Samples Collected			Samples Collected			Samples Collected			Samples Collected			water			water		
MP-5-9.5	9.5	10		due to Winter Conditions			due to Winter Conditions			due to Winter Conditions			due to Winter Conditions			no flow			no flow		
MP-6-3.5	3.5	4														no flow			water		
MP-6-9.5	9.5	10														water			water		
MP-7-6	6	6.5	O_2 Sensor	1.8	na	na	malf	na	na	water	na	na	water	na	na	Water covering sensor			Water covering sensor		
MP-8-9	9	9.5	O_2 Sensor	water	na	na	16.0	na	na	4.4	na	na	water	na	na	Water covering sensor			Water covering sensor		
MP-8-5.5	5.5	6														water			water		
MP-8-12.5	12.5	13														water			water		
MP-9-4.5	4.5	5														no flow			water		
MP-9-6	6	6.5	O_2 Util. Rate = 0.01%/hr[3]	19.1	na	na	15.3	na	na	12.0	na	na	5.7	na	na	Water covering sensor			Water covering sensor		
MP-10-7.5	7.5	8														water			water		
MP-10-11.5	11.5	12														water			water		
MP-11-6	6	6.5	O_2 Sensor	20.7	na	na	19.2	na	na	16.1	na	na	15.0	na	na	8.6	na	na	13.2	na	na
MP-12-4.5	4.5	5														no flow			no flow		
MP-12-8.5	8.5	9														water			water		
MP-13-5.5	5.5	6														water			water		
MP-14-5.5	5.5	6														water			water		

[1] Maximum pressure before potential for fracturing of soil. Calculated at top of screen assuming density of soil is 100 lbs/ft^3.
[2] O_2 result represents daily average for month.
[3] Test performed on this oxygen sensor in January 1998 (see Table 3-1 footnote 3).
na = not applicable; malf = malfunctioned.

Fuel Tank Farm Groundwater Levels from February through July 1997

Well No	Well Depth below TOC	Top of Screen below TOC	Jan-96	Feb-96	Mar-96	Apr-96	May-96	Jun-96
AW-1	15.7	5.9	12.7	12.8	13.2	11.1	7.6	9.3
AW-2	16.3	6.5	16.3	13.4	13.6	6.8	3.6	9.3
AW-3	16.3	6.8	10.7	13.8	13.1	6.3	6	7.3
AW-4	16.2	6.4	15.7	16.2	16	9.15	3.6	9.3
AW-5	16.2	6.5	13.8	16.2	13.1	6.7	7.7	8.8
AW-6	16.2	6.5	9.6	13.5	12.8	9.5	9.1	9.7
AW-7	16.3	6.3	16.3	16.3	6.3	6.3	6.8	6.4
AW-8	16.3	6.5	9.7	13.2	12.7	9.5	9	9.4
AW-9	16.2	6.5	12.9	12.9	12.4	9.4	9.5	8.9
AW-10	16.3	6.8	12.9	13.2	13.8	8.9	7.8	8.5
AW-11	16.7	6.9	16.7	16.7	16.7	11.1	9.2	11
AW-12	16.5	6.8	15.3	16	15.4	11	9.4	10.2
AW-13	16.4	6.7	16.4	16.4	16.4	12.7	9.5	10.8
AW-14	16.2	6.5	16.2	16.2	16.2	10.4	8.4	9.3
AW-15	16.3	6.8	16.3	16.3	16.3	11.4	6.3	13.2
AW-16	16.2	6.5	16.2	16.2	13	9.3	7.4	8.3
AW-17	16.7	6.6	15.3	15.8	13.8	10.2	9.2	9.6
AW-18	16.3	6.5	12.7	13	11.4	7.6	6.6	7.6
AW-19	16.3	6.6	16.3	16.3	16.3	9.3	8.5	11
AW-20	16.2	6.5	13.8	14.5	12.8	8.95	8	8.5
AW-21	16.3	6.8	15.3	14.9	14.6	8.8	2.8	9.6
AW-22	16.3	6.6	13	13.1	14.2	6.1	4	11.8
AW-23	16.3	6.5	14.4	14.2	13	7.8	7.2	8.9
AW-24	16.3	6.6	15.4	10	9.8	6.4	2.5	9.3
AW-25	16.3	6.5	16.3	16.3	16.3	10	6.8	11.3
AW-26	16.3	6.6	16.3	16.3	16.3	10.1	8	11.2
AW-27	16.3	6.6	15.5	15.2	14.8	7.1	3.1	10.3
AW-28	16.3	6.6	16.3	16.3	16.3	11.1	6.4	12.6
AW-29	16.4	6.6	16.4	16.4	10.8	7.5	6.6	11.3
AW-30	16.3	6.6	16.3	16.3	16.3	7.5	5	12.7
AW-31	16.2	6.5	16.2	16.2	16.2	10.6	10.9	13.5
AW-32	16.3	6.5	16.3	16.3	16.3	11	10.8	12.1
AW-33	16.3	6.3	16.3	16.3	16.3	16.3	10.2	11.3
AW-34	16.5	6.5	16.5	16.5	16.5	16.5	10.3	11.4
AW-35	16.7	6.4	16.7	16.7	16.7	9.1	6.3	12.4
AW-36	16.5	6.4	16.5	16.5	16.5	11.7	10.1	10.7
AW-37	16.3	6.6	9	9.6	6.6	4.6	6.4	6

Bolded value: indicates water level is at or above the top of the screen.

1998 Groundwater Levels along East/West Transect at FTF II - AST 7810

Well No.	Elevation at top of casing (ft amsl)	Elevation at ground (ft amsl)	Elevation of water - FEB. (ft amsl)	Elevation of water - APR. (ft amsl)	Elevation of water - JUN. (ft amsl)	Depth to top of screen (ft)	Elevation to TOS (ft amsl)	Depth to bottom of screen (ft)	Elevation to BOS (ft amsl)
AW-1	893.22	891.73	878.83	880.63	882.43	5.9	885.83	15.7	876.03
AW-2	891.25	889.58	878.18	882.78	880.28	6.5	883.08	16.3	873.28
AW-4	890.89	889.12	875.32	879.97	879.62	6.4	882.72	16.2	872.92
AW-5	890.49	888.75	872.55	882.05	879.95	6.5	882.25	16.2	872.55
AW-6	890.5	888.84	872.64	879.34	879.14	6.5	882.34	16.2	872.84
AW-8	890.28	888.6	875.4	879.1	879.2	6.5	882.1	16.3	872.3
AW-9	889.92	888.1	875.2	878.7	879.2	6.5	881.6	16.2	871.9
AW-10	889.41	887.71	874.51	878.81	879.21	6.8	881.11	16.3	871.41

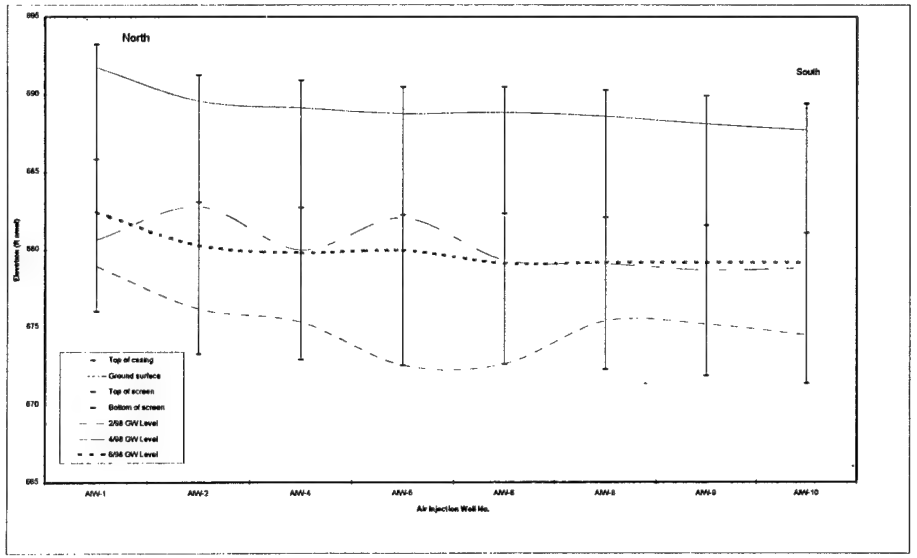
Boxed value: indicates water level is at or above the top of the screen.

1998 Groundwater Levels along East/West Transect at FTF II - AST 7820

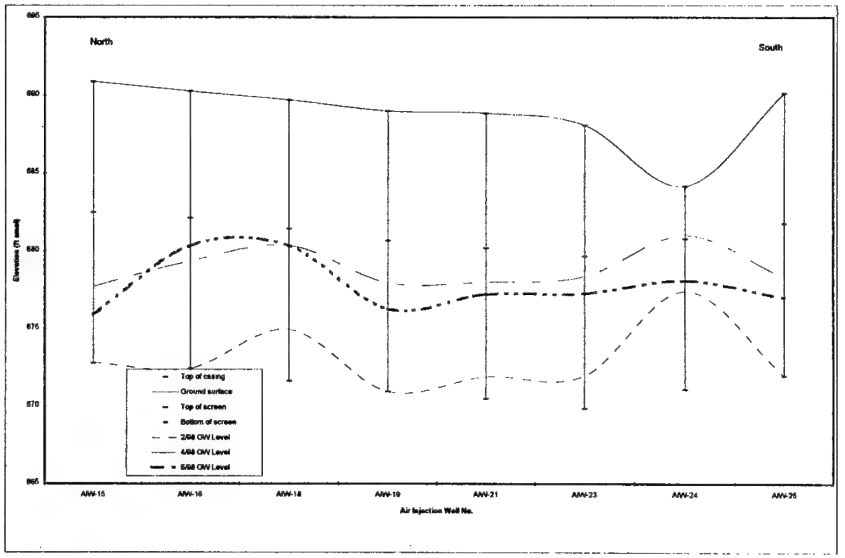
Well No.	Elevation at top of casing (ft amsl)	Elevation of ground (ft amsl)	Elevation of water - FEB. (ft amsl)	Elevation of water - APR. (ft amsl)	Elevation of water - JUN. (ft amsl)	Depth to top of screen (ft)	Elevation to TOS (ft amsl)	Depth to bottom of screen (ft)	Elevation to BOS (ft amsl)
AW-15	890.86	889.09	872.79	877.69	875.89	6.8	882.49	16.3	872.8
AW-16	890.25	888.62	872.42	879.32	880.32	6.5	882.12	16.2	872.4
AW-18	889.68	887.93	874.93	880.33	880.33	6.5	881.43	16.3	871.6
AW-19	888.96	887.25	870.95	877.85	878.25	6.6	880.65	16.3	871.0
AW-21	888.83	886.79	871.89	877.99	877.19	6.6	880.19	16.3	870.5
AW-23	888.07	886.16	871.96	878.36	877.26	6.5	879.66	16.3	869.9
AW-24	884.17	887.39	877.39	880.99	878.09	6.6	880.79	16.3	871.1
AW-25	890.14	888.27	871.97	878.27	878.97	6.5	881.77	16.3	872.0

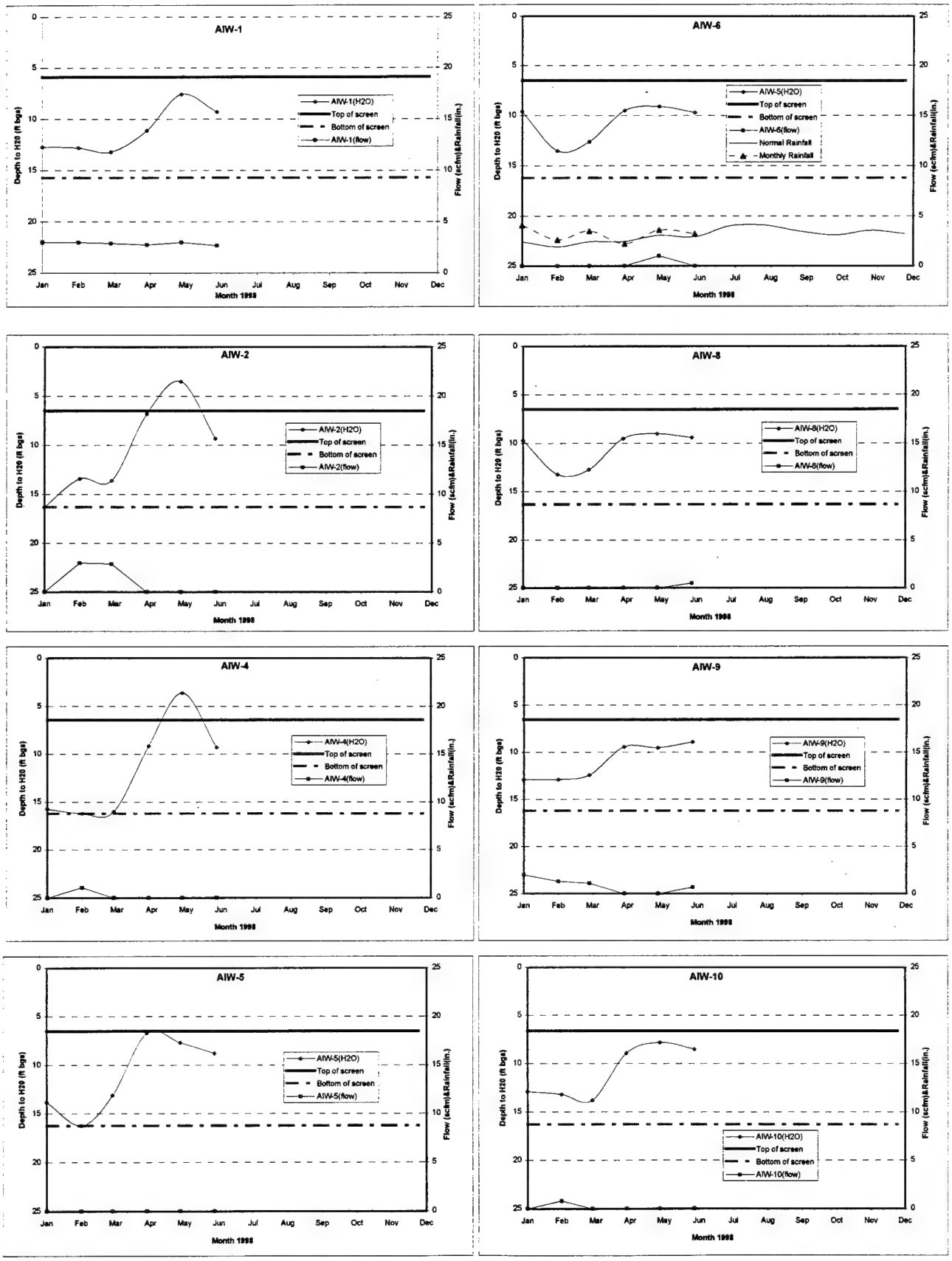
Bolded value: indicates water level is at or above the top of the screen.

East/West Cross Section at FTF - AST 7810 (see Figure 10-1 for transect location)



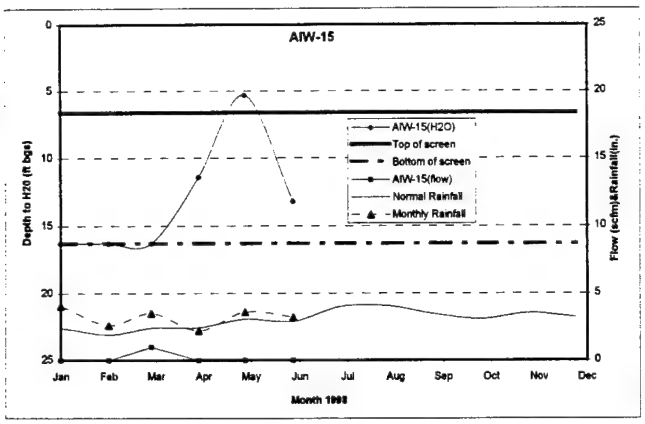
East/West Cross Section at FTF - AST 7820 (see Figure 10-1 for transect location)

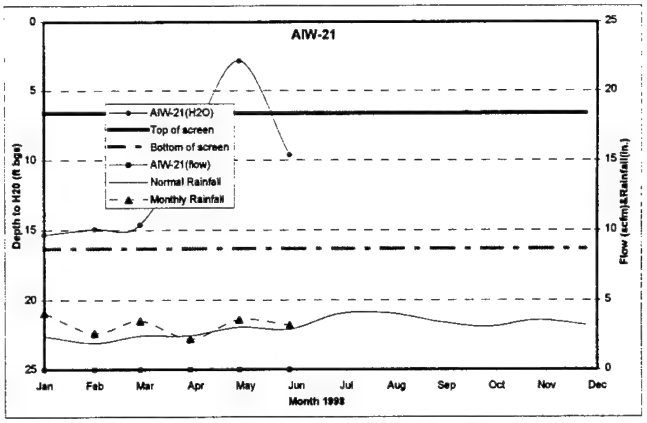


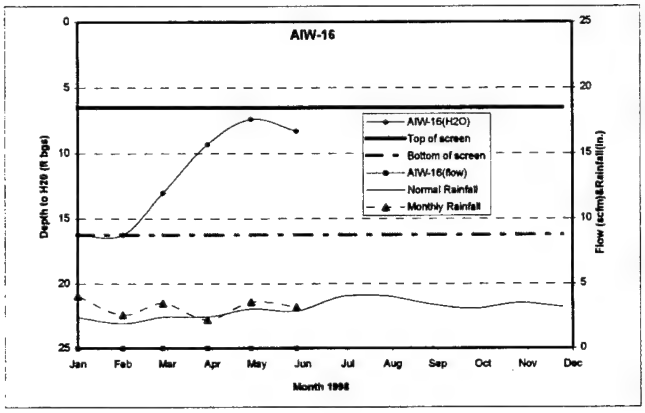


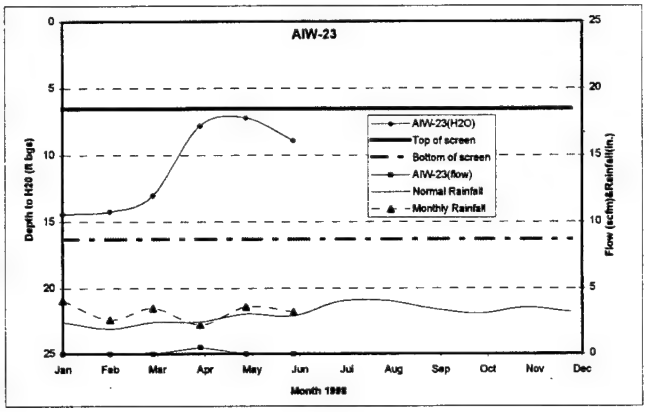
See Figure 10-1 for transect location.

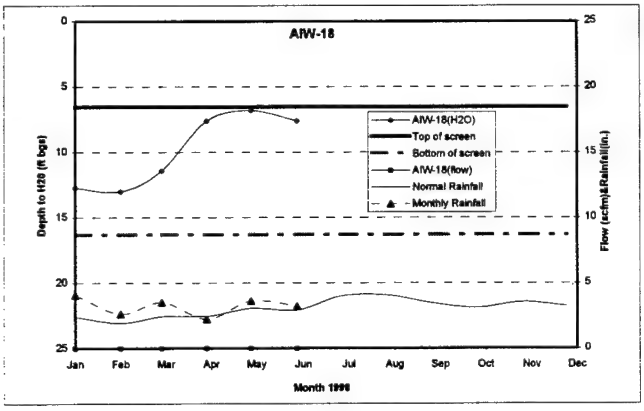
Figure 10-2 FTF II Groundwater/Air Flow Relations - AST 7810 Area

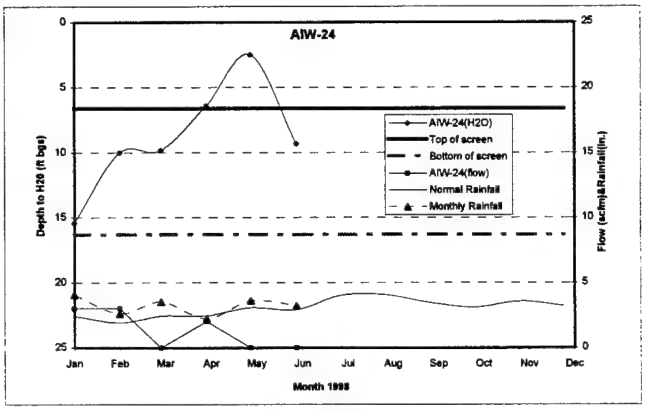


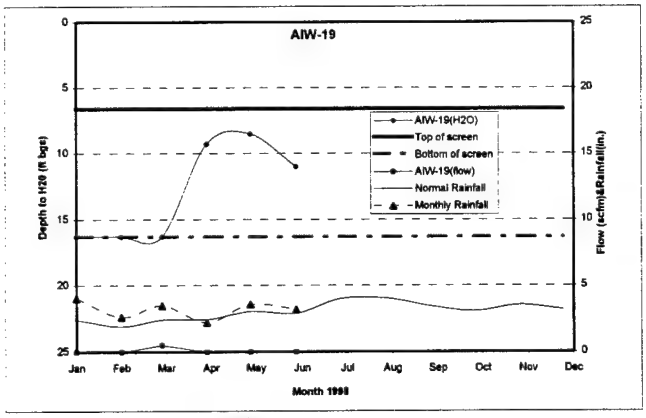


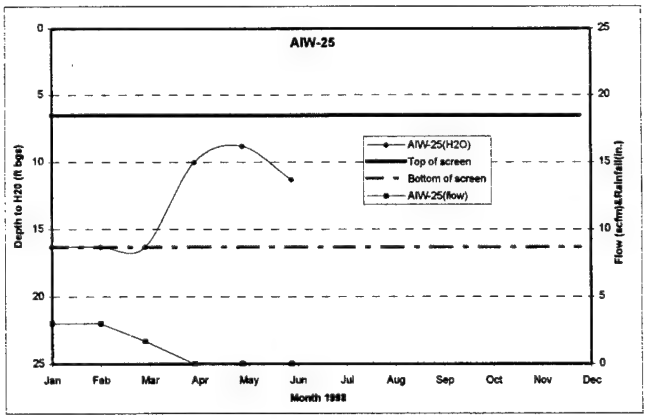






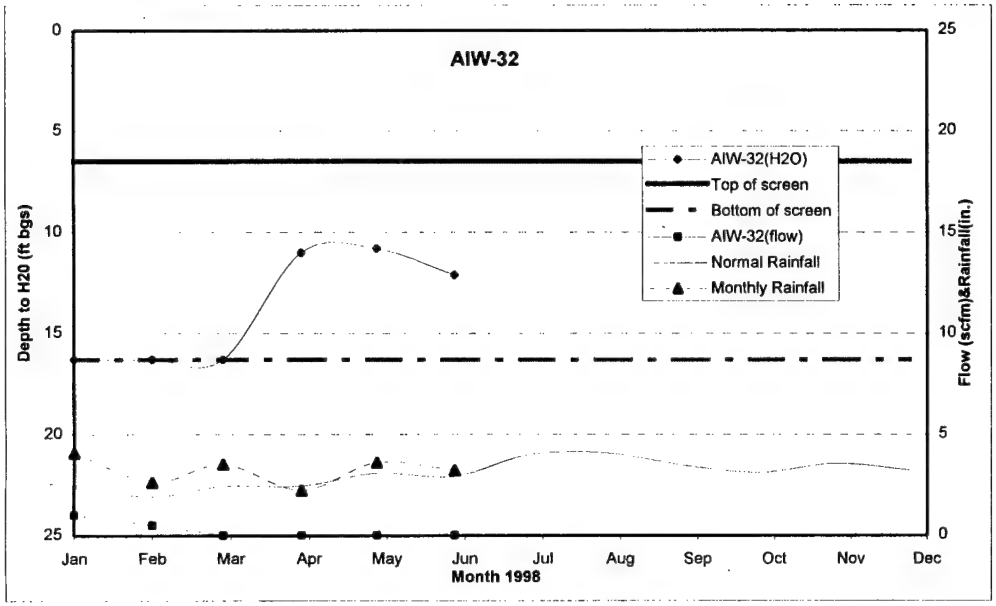


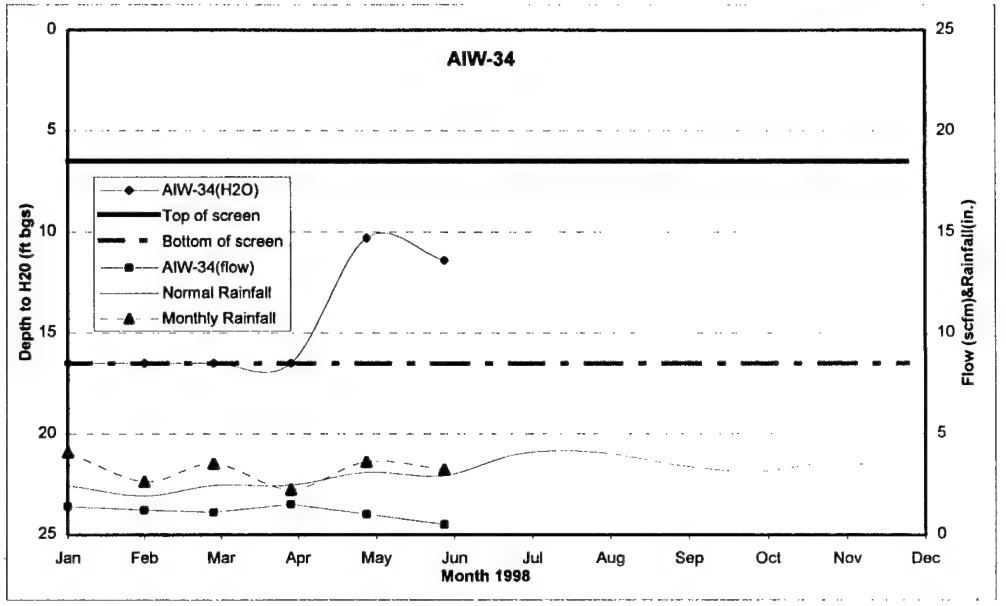


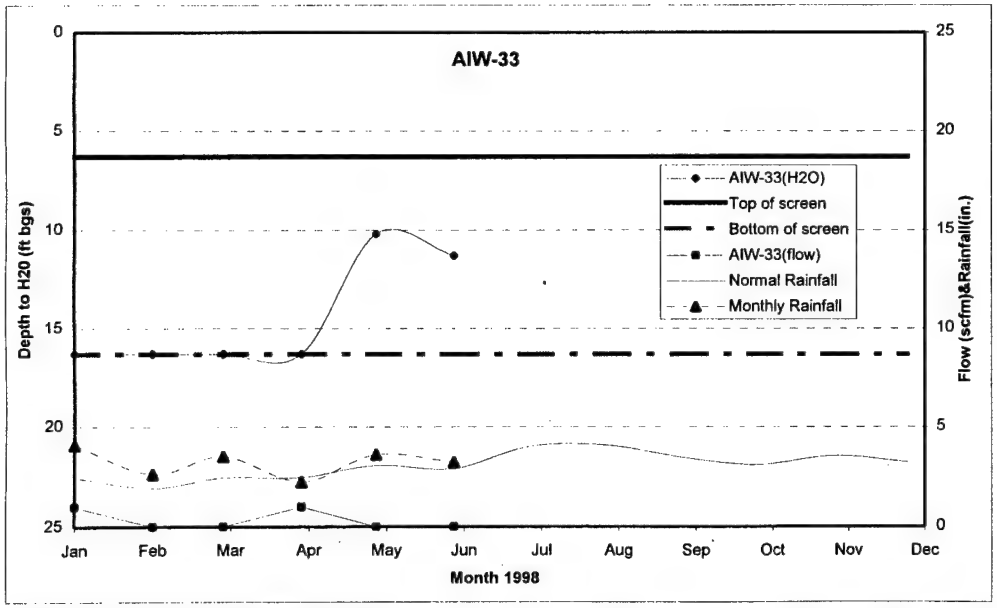


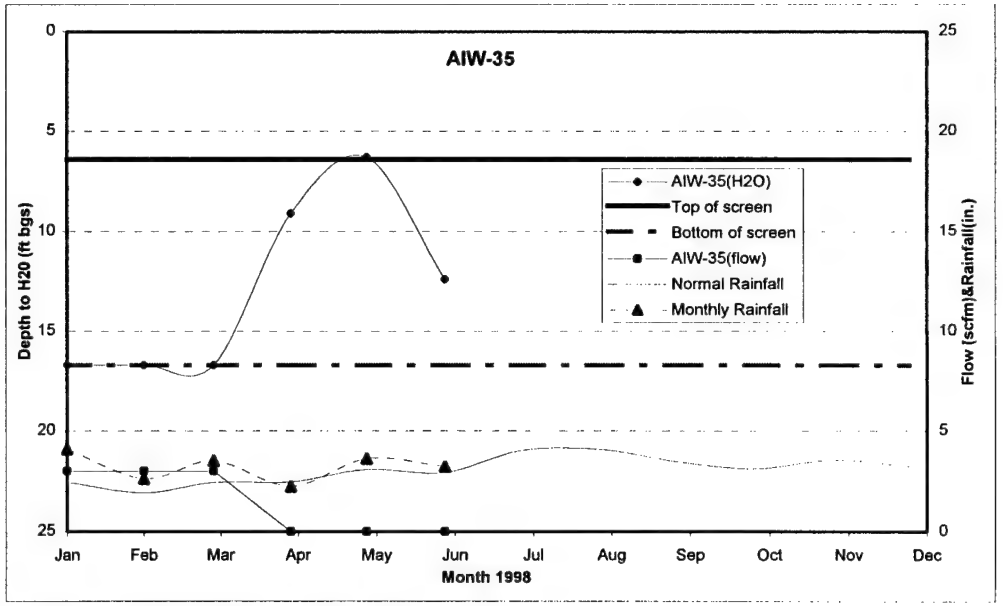
See Figure 10-1 for transect location.

Figure 10-3 FTF II Groundwater/Air Flow Relations - AST 7820 Area









See Figure 10-1 for transect location.

Figure 10-4 FTF II Groundwater/Air Flow Relations - AST 7830

11.0 NOSE DOCK AREA #1

11.1 OPERATIONS

COE installed the 8 NDA biovent systems in OU 5 during the fall of 1996 and initiated system startup in October and November. The COE biovent removal action report for these systems presents relevant data. BEI began formal O&M on December 1, 1996. Since BEI assumed responsibility for O&M, the NDA-1 system had operated 580 days through June 30, 1998. NDA-1 and NDA-3 were connected together on January 19, 1998 under the blower located at NDA-1.

11.2 CONCLUSIONS AND RECOMMENDATIONS

Individual wellhead flow has been monitored since December 1996, allowing long-term performance to be evaluated. Figure 11-1 (foldout) presents the biovent system AIW and MP layouts for all of the NDAs. Table 11-1 presents the wellhead flow measurements and soil gas results for NDA-1. For comparison, Figure 11-1 presents the average air flow rate per well over the reporting period along with MP oxygen data.

As depicted on Figure 11-1, most AIWs (15 of 24) averaged above 50 percent of the well-specific design flows; only AIWs-1-3, 1-5, 1-21, 1-22, and 1-24 did not allow any air to be injected during the reporting period. This condition is similar to the 6-month period prior to this reporting period, although air flow was extremely low in May. Figure 11-2 includes graphs that illustrate the fluctuating groundwater levels and air flow at specific wells identified along the cross section on Figure 11-1. Table 11-2 lists all of the groundwater levels at each AIW.

The deep zones of MPs-1-1, 1-3, and 1-4 remain inundated with water. The lowest oxygen levels at NDA-1 were noted at MP-1-6 (1.1 to 1.3 percent). AIW-1-21, north of MP-1-6, has typically been at zero air flow. Nearby AIWs-1-9 and 1-10 were fully inundated during the months of April and May. Once AIW-1-9 and 1-10 came online, the oxygen level increased to 18.3 percent (see Month of June results in Table 11-1).

Respiration testing was performed on MP-1-6-5 and MP-1-6-8 (Figure A-19). Both results, 0.11 and 0.45 percent/hour, respectively, are lower than noted during the fall of 1997 (Table 1-3 or Figure 11-1). The MP 1-6-8 results indicate that biodegradation is still occurring. MP 1-6-5 rate is similar to the spring 1997 rate of 0.16 percent/hour. The oxygen utilization rate at MP 1-6-5 was at 0.34 in the fall of 1997. This fluctuation cannot be explained. An average of these three readings at MP 1-6-5 may be more accurate. In this case, the average rate of 0.2 percent/hour would indicate that the soils are very close to being considered at background levels.

Overall Recommendation for NDA-1: An increase in air flow near MP-1-6 is recommended, primarily by increasing air flow into AIW-1-9, AIW-1-10, and AIW-1-23. Confirmation soil samples to be collected throughout NDA-1 in 1998 should be evaluated to determine whether bioventing should be continued or another alternative should be considered.

Table 11-1 NDA-1 Air F[redacted]and Monitoring Point Data

Air Injection Well	Screen Interval top[1]	Screen Interval bottom[1]	Overburden Pressure[2] (psi)	Design Air Flow (scfm)	Individual Well Head Flow (scfm) January 1998	February 1998	March 1998	April 1998	May 1998	June 1998	Average Jan - Jun
AIW-1	12	22	8.3	15.0	9	11	12	13	10	12	11.2
AIW-2	6	21	4.2	14.0	11	11	10	12	10	11.5	10.9
AIW-3	13	24	9.0	13.0	0	0	0	0	0	0	0.0
AIW-4	7	18	4.9	13.0	13	13	12	13	12.5	13	12.8
AIW-5	11.3	21.3	7.8	13.0	0	0	0	0	0	0	0.0
AIW-6	18.75	29.75	13.0	13.0	13	13	13	13	1	13	11.0
AIW-7	15	30	10.4	13.0	4.5	4.5	1	3	0	7	3.3
AIW-8	16	26	11.1	13.0	12	13	13	8	0	9.5	9.3
AIW-9	12	23	8.3	10.0	10	10	10	9	off	10	9.8
AIW-10	12	23	8.3	10.0	10	10	10	8	off	10	9.6
AIW-11	17	28	11.8	12.0	9	9	8	0	0	0	4.3
AIW-12	16	27	11.1	12.0	2	0	1	5	0	5	2.2
AIW-13	16	27	11.1	12.0	12	12	12	7	0	6	8.2
AIW-14	15	26	10.4	12.0	12	12	12	8	0	8.5	8.8
AIW-15	10	21	6.9	11.0	11	11	9	10	0	9	8.3
AIW-16	13	24	9.0	11.0	11	11	11	11	0	11	9.2
AIW-17	14	25	9.7	11.0	11	11	11	0	0	0	5.5
AIW-18	14	24	9.7	11.0	11	11	11	10	0	9	8.7
AIW-19	14	25	9.7	11.0	11	11	11	4	0	4	6.8
AIW-20	12.5	23.5	8.7	11.0	9	10	5	0	0	2	4.3
AIW-21	12	23	8.3	10.0	0	0	0	0	0	0	0.0
AIW-22	13	24	9.0	10.0	0	0	0	0	off	0	0.0
AIW-23	13	24	9.0	10.0	10	9.5	10	0	off	0	5.9
AIW-24	13	24	9.0	10.0	0	0	0	0	0	0	0.0
Total air flow:				281.0	191.5	193.0	182.0	134.0	33.5	140.5	
Pressure (psi):					2.8	2.7	2.5	3.1	2.5	3.2	

Monitoring Point	Screen Interval (ft bgs) top	bottom		Soil Gas Sampling Results January 1998 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	February 1998 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	March 1998 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	April 1998 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	May 1998 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	June 1998 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)
MP 1-1-6.5	6.5	7														20.7	0.0	2.1	20.6	0.0	18
MP 1-1-13.5	13.5	14															no flow			no flow	
MP 1-2-7-L	7	7	O_2 Sensor	16.9	na	na	15.7	na	na	18.7	na	na	19.7	na	na	17.3	na	na	18.1	na	na
MP 1-3-5.5	5.5	6														17.2	0.3	0.5	19.7	0.2	0.3
MP 1-3-11.5	11.5	12		No Soil Gas			No Soil Gas			No Soil Gas			No Soil Gas				no flow			water	
MP 1-4-8	8	8.5		Samples Collected			Samples Collected			Samples Collected			Samples Collected				water			water	
MP 1-4-13	13	13.5		due to Winter Conditions			due to Winter Conditions			due to Winter Conditions			due to Winter Conditions				water			water	
MP 1-5BG-7	7	7.5	Background location														water			no flow	
MP 1-6-5	5	5.5	O_2 Util. Rate = 0.11%/hr[4]													1.3	6.8	flame out	18.3	1.1	0.3
MP 1-6-8	8	8.5	O_2 Util. Rate = 0.45%/hr[4]													1.1	6.6	flame out	9.6	4.1	6100

[1] Measured from top of casing.

[2] Maximum pressure before potential for fracturing of soil. Calculated at top of screen assuming density of soil is 100 lbs/ft^3.

[3] O_2 result represents daily average for month.

[4] Test performed on 6/25/98.

na = not applicable

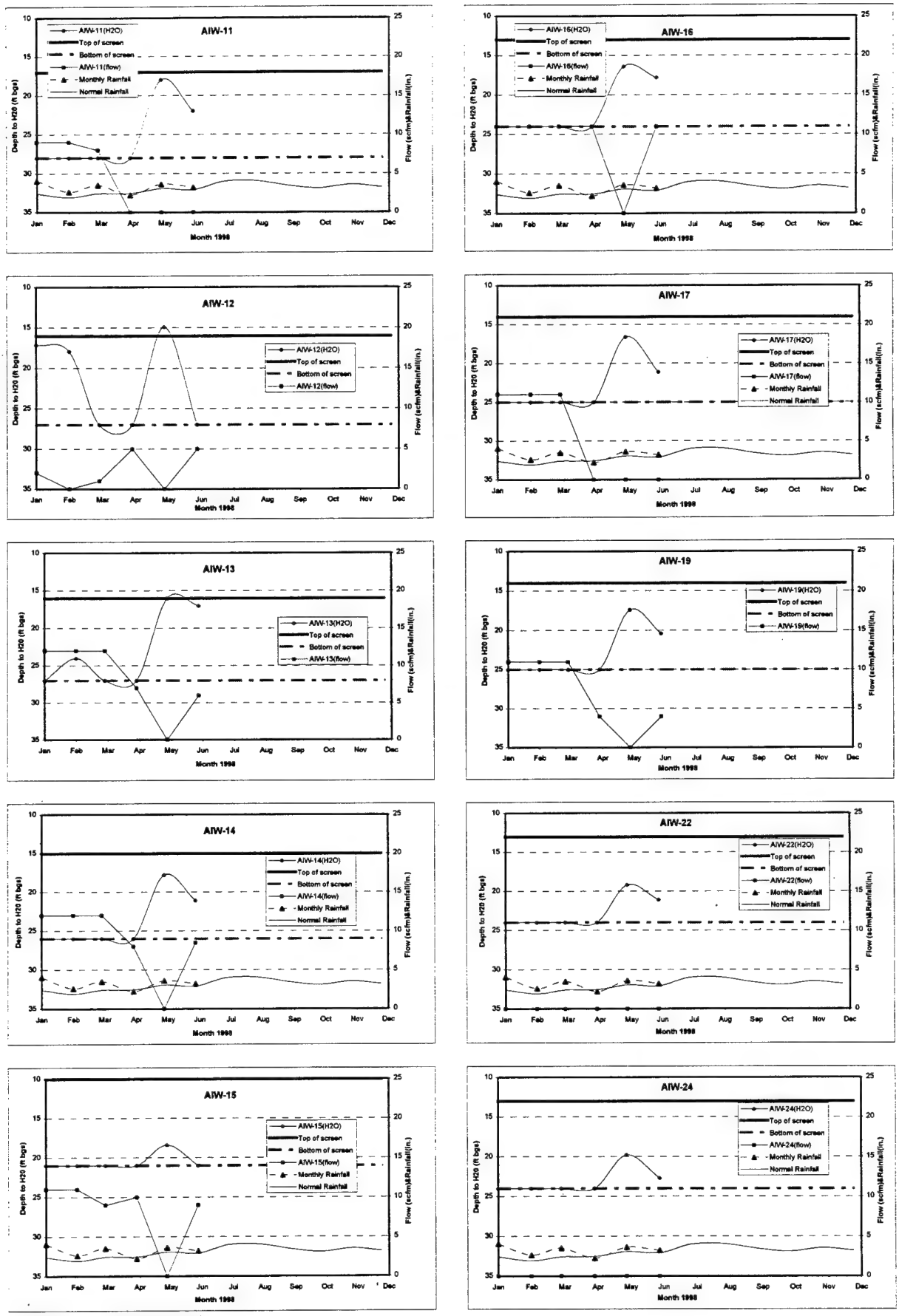
NOTE: AIWs that are noted to be "off" have been shutdown due to well seal leaks.

NOTE: Flame out occurs due to low oxygen levels.

Table 11-2 NDA-1 Groundwater Level Data

WELL NO	Well Depth below TOC (ft)	Top of Screen below TOC (ft)	Groundwater Depth Below TOC (ft)											
			Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Apr-98	May-98	Jun-98
AIW-1	22	12	22.4	22	22	22	22	22	22	22	22	22	22.3	22
AIW-2	21	6	8.6	9.9	14.1	11.7	8.2	9.7	11.1	11.3	7	7.7	8.3	9.4
AIW-3	24	13	19.9	19.3	24	24	21.5	24	24	24	24	24	24	24
AIW-4	18	7	10.8	12.8	10.25	18	10.1	13	15	15.3	9.2	9.8	9.9	9.9
AIW-5	21.3	11.3	14.7	12.9	16.2	16.7	14.9	15.3	16	16.5	15.3	15.5	13.7	15.3
AIW-6	29.75	18.75	22.9	25.9	29.75	29.75	29.75	29.75	29.75	29.75	29.75	23.2	18.9	22.7
AIW-7	30	15	30	25.8	30	30	30	30	30	30	30	30	30	30
AIW-8	26	16	26	26	26	26	26	26	26	26	26	26	19.8	26
AIW-9	23	12	**11**	**11.5**	**11.1**	off	off	**11.3**	**11.3**	**23**	23	**9**	**11**	12.9
AIW-10	23	12	12.4	**11.6**	**11.4**	off	off	**11.8**	**11.4**	**11.4**	23	**10.5**	**11.2**	**11.7**
AIW-11	28	17	22.1	28	25	28	28	28	28	28	28	28	18	22
AIW-12	27	16	16.1	14.3	17.3	21.2	18.4	19	17.1	17.9	27	27	**14.9**	27
AIW-13	27	16	20.2	23.9	18.8	27	27	20.6	27	24	27	27	**16**	17
AIW-14	26	15	21.7	26	26	26	26	26	26	26	26	26	17.8	21.1
AIW-15	21	10	21.5	21	21	21	21	21	21	21	21	21	18.4	21
AIW-16	24	13	17.7	21.5	24	24	24	24	24	24	24	24	16.4	17.8
AIW-17	25	14	21.6	21.8	25	25	25	25	25	25	25	25	16.6	21.1
AIW-18	24	14	**10.3**	24	24	24	24	24	24	24	24	24	14.9	15.3
AIW-19	25	14	23.3	23.6	25	25	25	25	25	25	25	25	17.4	20.4
AIW-20	23.5	12.5	19.9	21.4	23.5	23.5	23.5	21.7	23.5	23.5	23.5	17.9	11.2	15.7
AIW-21	23	12	23	23	23	23	23	23	23	23	23	13.1	12.2	23
AIW-22	24	13	15.6	20.1	24	24	24	24	24	24	24	24	19.2	21.1
AIW-23	24	13	20.9	21.9	24	24	24	24	24	24	24	24	12.6	11
AIW-24	24	13	23	23.1	24	24	24	24	24	24	24	24	19.8	22.7

Bolded value indicates water level is at or above the top of the screen.
TOC = top of casing.



See Figure 11-1 for transect location.

Figure 11-2 Air Flow vs. Depth to Groundwater at NDA-1

12.0 NOSE DOCK AREA #2

12.1 OPERATIONS

COE installed the 8 NDA biovent systems in OU 5 during the fall of 1996 and initiated system startup in October and November. The COE biovent removal action report for these systems presents relevant data. BEI began formal O&M on December 1, 1996. Since BEI assumed responsibility for O&M, the NDA-2 system had operated 580 days through June 30, 1998.

12.2 CONCLUSIONS AND RECOMMENDATIONS

MP 2-2 continues to exhibit high oxygen and low carbon dioxide levels, suggesting either that contamination does not exist or that the MPs may be short-circuiting via permeable zones (Table 12-1). Either of these scenarios are possible due to the fact that the oxygen levels, when measurable, have always been above 20 percent. MP 2-2 lies approximately 100 ft to the west of MP 1-6, which had the lowest oxygen levels in NDA-1 (see Figure 11-1). This difference in oxygen levels supports the conceptual model (Figure 1-2) that perched lenses may be avenues to the movement of injected air. The oxygen level of 20.7 percent recorded at MP 2-2 in June was recorded after the system had been shut down for several days. All other MPs except the oxygen sensor at MP 2-11 had no flow or water; therefore, no data could be collected from these points. Water levels are listed on Table 12-2. The oxygen levels at the MP 2-11 oxygen sensor remained similar to those in the last half of 1997. A low oxygen level in MP 2-11 coupled with the low system-wide air injection rates during May, suggests that biodegradation is occurring in the vicinity of MP 2-11. High groundwater has not caused problems at NDA-2 AIWs—during the reporting period, only AIW-2 was fully inundated (March and April).

Respiration tests could not be performed in June due to saturated MPs.

Overall Recommendation for NDA-2: High oxygen levels may indicate that cleanup is complete in these areas. Perform fall respiration test at MP 2-11 which contains an oxygen sensor. Soil samples to be collected throughout NDA-2 in 1998 should be evaluated to determine whether bioventing should be continued.

Table 12-1 NDA-2 Air Flow and Monitoring Point Data

Air Injection Well	Screen Interval top[1]	Screen Interval bottom[1]	Overburden Pressure[2] (psi)	Design Air Flow (scfm)	Individual Well Head Flow (scfm) January 1998	February 1998	March 1998	April 1998	May 1998	June 1998	Average Jan - Jun
AIW-1	14	25	9.7	11.0	11	11	11	6	0	9	8.0
AIW-2	11	22	7.6	9.0	9	9	7	0	1	8	5.7
AIW-3	7	18	4.9	11.0	11	11	1	0	0	5	4.7
AIW-4	11	22	7.6	9.0	0	0	0	0	0	0	0.0
AIW-5	13.5	23.5	9.4	11.0	11	11	11	9	2	10.5	9.1
AIW-6	10	21	6.9	9.0	9	9	8.5	0	5	9	6.8
AIW-7	13	24	9.0	10.0	10	10	10	6	0	9	7.5
AIW-8	10.5	21.5	7.3	10.0	10	10	10	10	5	10	9.2
AIW-9	6	13	4.2	12.0	0	0	0	0	0	0	0.0
AIW-10	11	22	7.6	9.0	9	9	10	9	5.5	9	8.6
AIW-11	4	15	2.8	9.0	0	4	9	9	7	9	6.3
AIW-12	8	19	5.6	10.0	10	10	9	8	3	10	8.3
AIW-13	12	23	8.3	10.0	10	10	10	10	5.5	10	9.3
AIW-14	11	22	7.6	9.0	9	9	9	9	0	9	7.5
AIW-15	9	19	6.3	12.0	12	12	12	11	11	12	11.7
AIW-16	10	20	6.9	12.0	0	0	0	0	0	0	0.0
AIW-17	9	20	6.3	8.0	8	8	8	8	1	8	6.8
AIW-18	9	20	6.3	8.0	8	8	8	8	off	off	8.0
AIW-19	6	15	4.2	10.0	10	10	off	8	2	3	6.6
AIW-20	9.5	20.5	6.6	10.0	10	10	10	10	7	10	9.5
AIW-21	9	20	6.3	10.0	10	10	8	7	6	8	8.2
AIW-22	8	19	5.6	8.0	8	8	8	8	7.5	8	7.9
AIW-23	7	18	4.9	7.0	7	7	7	7	0	7	5.8
Total air flow:				224.0	182.0	186.0	166.5	143.0	68.5	163.5	
Pressure (psi):					3.6	3.3	2.5	2.5	2.5	3.3	

Monitoring Point	Screen Interval (ft bgs) top	bottom		Soil Gas Sampling Results: January 1998 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	February 1998 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	March 1998 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	April 1998 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	May 1998 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	June 1998 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)
MP 2-1-8	8	8.5															water			water	
MP 2-1-13	13	13.5		No Soil Gas			No Soil Gas			No Soil Gas			No Soil Gas				no flow			water	
MP 2-2-5	5	5.5		Samples Collected			Samples Collected			Samples Collected			Samples Collected			20.5	0.0	1290	20.7	0.0	0.3
MP 2-2-8	8	8.5		due to Winter Conditions			due to Winter Conditions			due to Winter Conditions			due to Winter Conditions			20.6	0.0	7.4	20.7	0.0	0.3
MP 2-8-8	8	8.5															water			water	
MP 2-8-15	15	15.5															no flow			water	
MP 2-9-6	6	6.5															water			no flow	
MP 2-9-12	12	12.5															no flow			no flow	
MP 2-10-8	8	8.5																			
MP 2-11-14.5	14.5	15	O_2 Sensor	17.0	na	na	16.7	na	na	16.1	na	na	15.7	na	na	13.7	na	na	19.0	na	na

[1] Measured from top of casing.

[2] Maximum pressure before potential for fracturing of soil. Calculated at top of screen assuming density of soil is 100 lbs/ft^3.

[3] O_2 result represents daily average for month.

na = not applicable

NOTE: AIW's that are noted to be "off" have been shutdown due to well seal leaks.

Table 12-2 NDA-2 Groundwater Level Data

WELL NO	Well Depth below TOC (ft)	Top of Screen below TOC (ft)	Groundwater Depth Below TOC (ft)											
			Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Apr-98	May-98	Jun-98
AIW-1	25	14	19	21.8	23.5	25	25	25	25	25	25	19.1	16.4	19
AIW-2	22	11	13.9	16.9	14.5	16	14.1	15.1	22	16.3	11	6.7	12.2	14.4
AIW-3	18	7	19.9	20.5	20.35	20.4	20.2	20.2	22.5	20.4	15.8	9.3	14.4	19.6
AIW-4	22	11	13.3	13.6	14.6	13.7	13	14.9	16.6	16.9	12.2	11.7	13.9	14.9
AIW-5	23.5	13.5	18.3	22.6	23.5	23.5	23.5	23.5	23.5	23.5	23.5	18.1	17.1	23.5
AIW-6	21	10	18.3	21	21	21	21	21	21	21	21	19.7	15.9	21
AIW-7	24	13	23.2	24	24	24	24	24	24	24	24	23.2	21.4	24
AIW-8	21.5	10.5	20.2	21.5	21.5	21.5	21.5	21.5	21.5	21.5	21.5	19.4	16.9	20.2
AIW-9	13	6	13	13	13	13	13	13	13	13	13	13	13	13
AIW-10	22	11	20	22	22	22	22	22	22	22	22	17.5	22	22
AIW-11	15	4	6.2	15	8.1	16	13.6	15	15	15	8.2	11.7	6.3	6.4
AIW-12	19	8	19	19	19	19	19	19	19	19	19	19	19	19
AIW-13	23	12	17.7	23	23	23	23	23	23	23	23	14.2	13.9	20.6
AIW-14	22	11	22.1	22	22	22	22	22	22	22	22	20.3	19.5	22
AIW-15	19	9	19	19	19	19	19	19	19	19	19	19	19	19
AIW-16	20	10	20	20	20	20	20	20	20	20	20	20	20	20
AIW-17	20	9	18.5	20	20	20	20	20	20	20	20	18.1	17.8	18.6
AIW-18	20	9	18.4	20	20	20	20	20	20	20	20	18	14.8	17.9
AIW-19	15	6	12.3	12.5	13.4	11.1	8.9	9.7	12	11.1	8.2	11.4	13.1	15.2
AIW-20	20.5	9.5	19.9	20.5	20.5	20.5	20.5	20.5	20.5	20.5	20.5	18.8	17.9	19.9
AIW-21	20	9	20	20	20	20	20	20	20	20	20	20	20	20
AIW-22	19	8	19	19	19	19	19	19	19	19	19	19	17.3	18.1
AIW-23	18	7	18	18	18	18	18	18	18	18	18	18	17.8	18

Bolded value indicates water level is at or above the top of the screen.
TOC = top of casing.

13.0 NOSE DOCK AREA #3

13.1 OPERATIONS

COE installed the 8 NDA biovent systems in OU 5 during the fall of 1996 and initiated system startup in October and November. The COE biovent removal action report for these systems presents relevant data. BEI began formal O&M on December 1, 1996. Since BEI assumed responsibility for O&M, the NDA-3 system had operated 603 days through June 30, 1998. NDA-1 and NDA-3 were connected together on January 19, 1998 under the blower located at NDA-1.

13.2 CONCLUSIONS AND RECOMMENDATIONS

As during the last reporting period, no MP data could be collected; saturated soils around the screens prevented respiration tests from being performed (Table 13-1). The low oxygen level in MP 3-3 may also be evidence of low level biodegradation. As shown on Figures 13-1 and 13-2, AIWs located along the transect (identified on Figure 11-1) were partially inundated or dry; Table 13-2 lists the 1998 groundwater levels. When an AIW did accept air, the air flow rate was typically greater than 50 percent of the design rate. AIWs-3-5, 3-9, and 3-11 through 3-21 did not show improvement from the last two reporting periods (all of 1997), typically not allowing any air flow (Figure 11-1 and Table 13-1). AIWs-3-14 and 3-21 were fully inundated with water during several months. Other AIWs not allowing air had minimal inundation, possibly attributable to low-permeability or saturated soils surrounding the screens.

Confirmation sampling will be performed during the summer of 1998.

Overall Recommendation for NDA-3: Soil samples collected throughout NDA-3 should be evaluated to determine whether bioventing should be continued for the entire NDA-3 area or portions thereof. A higher density of soil sampling (areally) is planned for the ineffective AIW area of NDA-3 (AIWs-3-11 through 3-19).

Table 13-1 NDA-3 Air Flow and Monitoring Point Data

Air Injection Well	Screen Interval top[1]	Screen Interval bottom[1]	Overburden Pressure[2] (psi)	Design Air Flow (scfm)	Individual Well Head Flow (scfm) January 1998	February 1998	March 1998	April 1998	May 1998	June 1998	Average Jan - Jun
AIW-1	18	28	12.5	11	10	off	0	0	off	off	3.3
AIW-2	18	28	12.5	11	8	7.5	7	0	0	0	3.8
AIW-3	18	28	12.5	11	11	11	11	0	0	0	5.5
AIW-4	11	21	7.6	5	5	4	1	5	0	4.5	3.3
AIW-5	13	23	9.0	5	0	0	0	0	0	0	0.0
AIW-6	9	19	6.3	6	5	6	6	6	6	6	5.8
AIW-7	8	18	5.6	5	5	5	5	5	5	5	5.0
AIW-8	6.5	16.5	4.5	9	9	9	0	8	off	off	6.5
AIW-9	14	24	9.7	10	0	0	0	0	0	0	0.0
AIW-10	16	26	11.1	10	6	5	5	0	0	0	2.7
AIW-11	7	25.5	4.9	10	0	0	0	0	0	0	0.0
AIW-12	16	26	11.1	10	0	0	0	0	0	0	0.0
AIW-13	16	26	11.1	10	0	0	0	0	0	0	0.0
AIW-14	15	25	10.4	9	9	9	3	9	off	off	7.5
AIW-15	15	25	10.4	9	0	0	0	0	0	0	0.0
AIW-16	15	25	10.4	9	0	0	0	0	0	0	0.0
AIW-17	14	25	9.7	9	0	0	0	0	0	0	0.0
AIW-18	15	25	10.4	9	0	0	0	0	0	0	0.0
AIW-19	15	25	10.4	9	0	0	0	0	0	0	0.0
AIW-20	18	28	12.5	6	0	0	0	0	0	0	0.0
AIW-21	18	28	12.5	6	0	0	0	0	0	0	0.0
Total air flow:				179	68.0	56.5	38.0	33.0	11.0	15.5	
Pressure (psi):					2.9	2.7	2.5	3.1	2.5	3.2	

Monitoring Point	Screen Interval (ft bgs) top	bottom		Soil Gas Sampling Results January 1998 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	February 1998 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	March 1998 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	April 1998 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	May 1998 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	June 1998 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)
MP 3-1-5.5	5.5	6		No Soil Gas			No Soil Gas			No Soil Gas			No Soil Gas			no flow			water		
MP 3-1-11.5	11.5	12		Samples Collected			Samples Collected			Samples Collected			Samples Collected			water			water		
MP 3-2-8.0	8	8.5		due to Winter Conditions			due to Winter Conditions			due to Winter Conditions			due to Winter Conditions			no flow			no flow		
MP3-2-14.0	14	14.5														water			water		
MP 3-3-11.5	11.5	12	O_2 Sensor	17.0	na	na	16.7	na	na	16.1	na	na	15.7	na	na	14.7	na	na	13.6	na	na

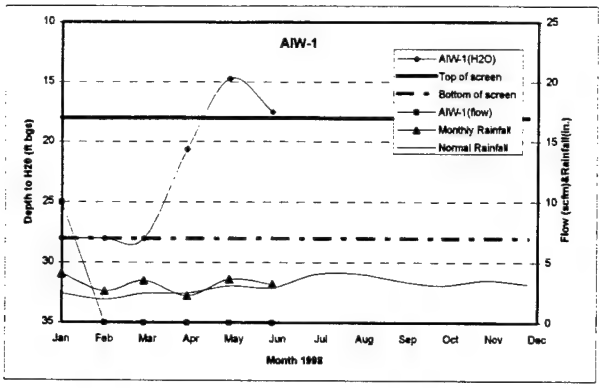
[1] Measured from top of casing.

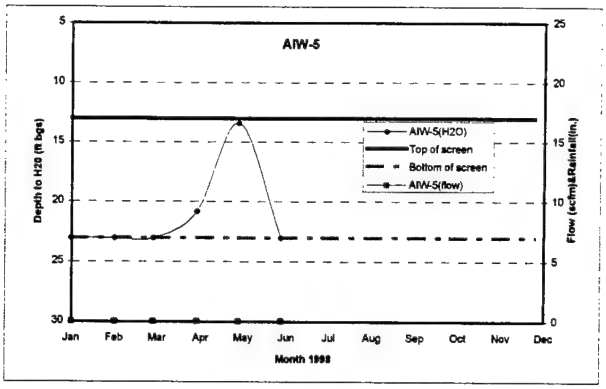
[2] Maximum pressure before potential for fracturing of soil. Calculated at top of screen assuming density of soil is 100 lbs/ft^3.

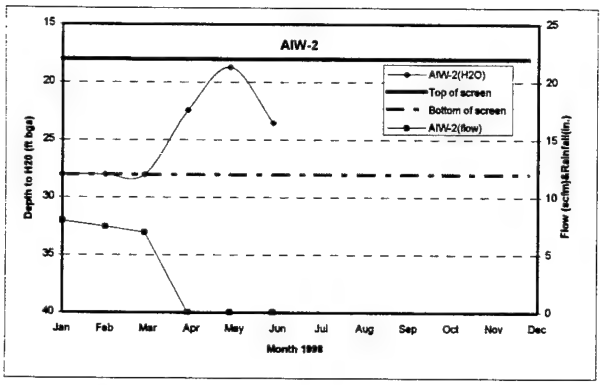
[3] O_2 result represents daily average for month.

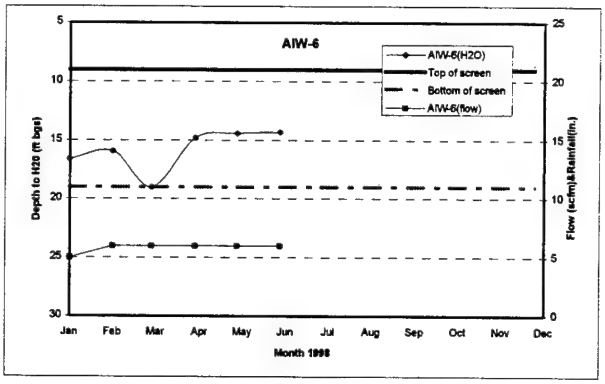
na = not applicable

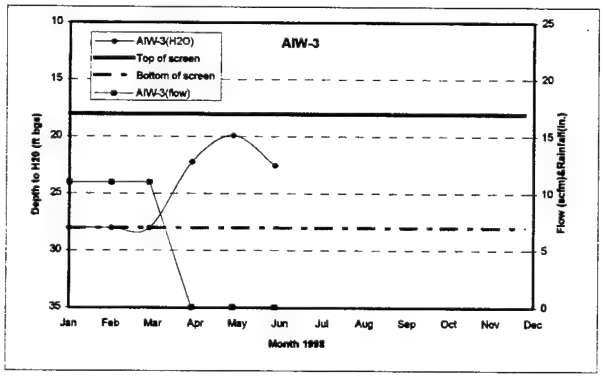
NOTE: AIWs that are noted to be "off" have been shutdown due to well seal leaks.

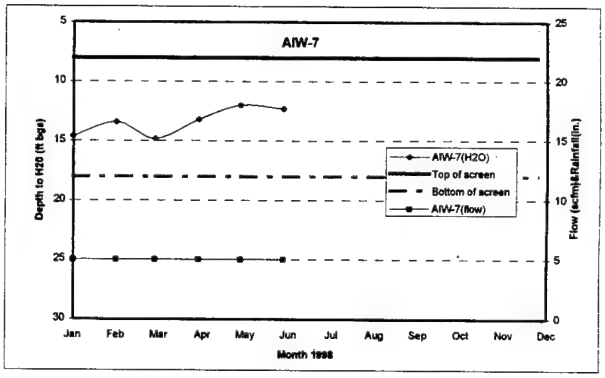


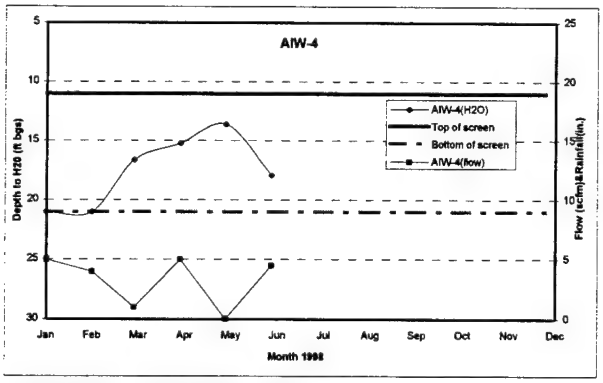


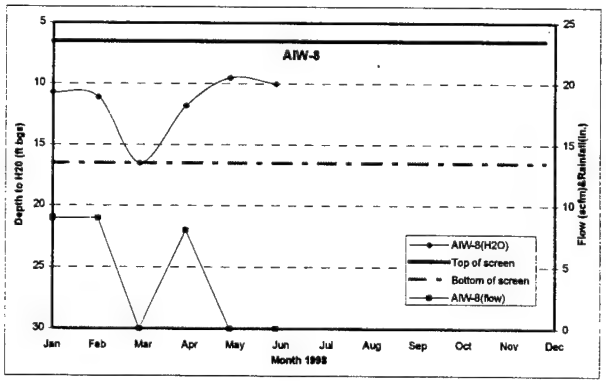






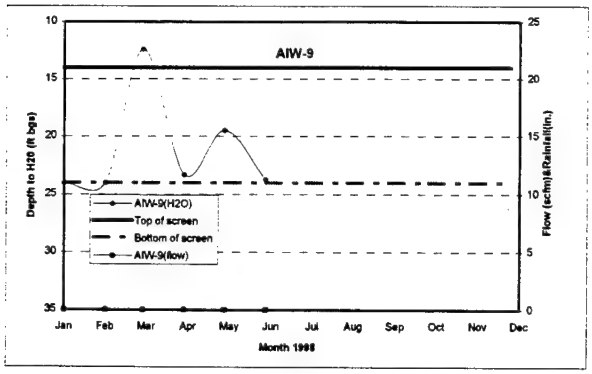


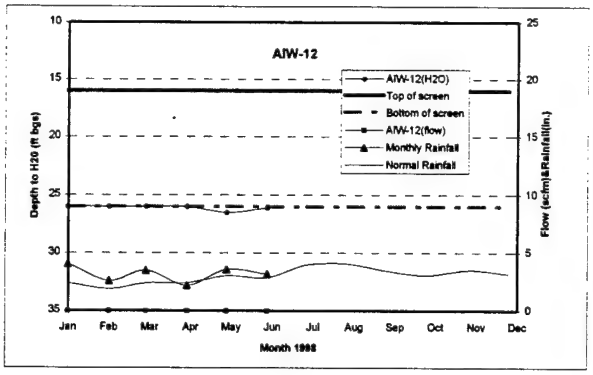


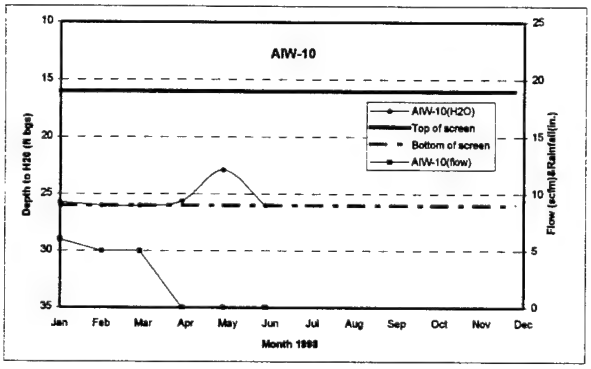


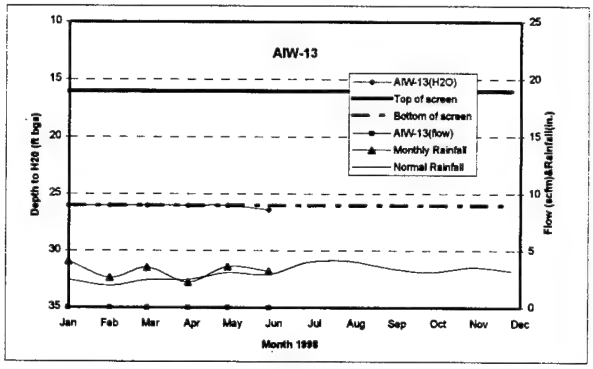
See Figure 11-1 for transect location.

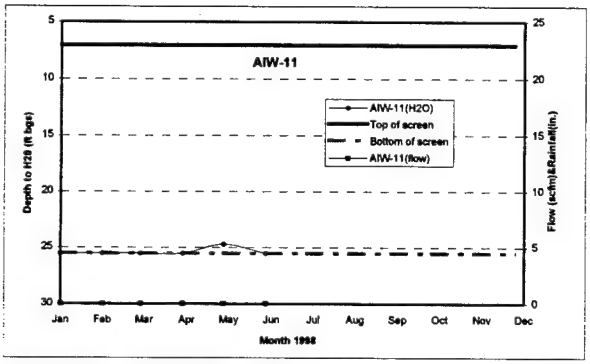
Figure 13-1 Air Flow vs. Depth to Groundwater at NDA-3

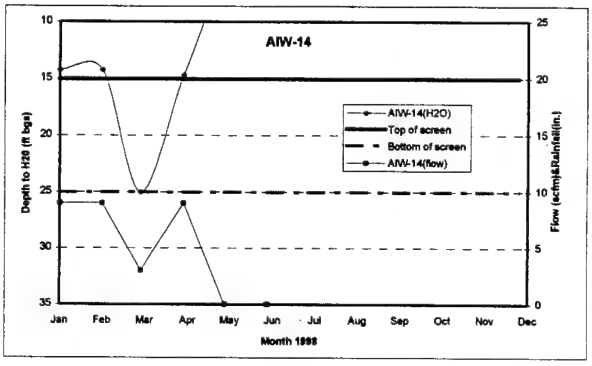












See Figure 11-1 for transect location.

Figure 13-2 Air Flow vs. Depth to Groundwater at NDA-3

Table 13-2 NDA-3 Groundwater Level Data

WELL NO	Well Depth below TOC (ft)	Top of Screen below TOC (ft)	Groundwater Depth Below TOC (ft)											
			Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Apr-98	May-98	Jun-98
AIW-1	28	18	**15.9**	22.1	25.15	25.2	28	28	28	28	28	20.6	**14.7**	**17.5**
AIW-2	28	18	24	28	28	28	28	28	28	28	28	22.4	18.7	23.5
AIW-3	28	18	21.8	28	28	28	28	28	28	28	28	22.2	19.9	22.5
AIW-4	21	11	20	21	21	21	21	21	21	21	16.6	15.2	13.6	17.9
AIW-5	23	13	23	23	23	23	23	23	23	23	23	20.8	13.4	23
AIW-6	19	9	14.6	15.1	15.05	16.2	16	15.9	16.6	15.9	19	14.8	14.4	14.3
AIW-7	18	8	13.4	14.3	14.5	14.1	13.3	14.1	14.6	13.4	14.8	13.2	12	12.3
AIW-8	16.5	6.5	11.1	11.7	11	11	9.2	11.6	10.7	11.1	16.5	11.8	9.5	10
AIW-9	24	14	24	24	24	24	24	24	24	24	12.4	23.3	19.5	23.7
AIW-10	26	16	25.8	26	25.7	26	26	26	25.7	26	26	25.6	22.9	26
AIW-11	25.5	7	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	24.7	25.5
AIW-12	26	16	26	26	26	26	26	26	26	26	26	26	26.5	26.1
AIW-13	26	16	26	26	26	26	26	26	26	26	26	26	26	26.4
AIW-14	25	15	**13.8**	**12.9**	**13.5**	**14.4**	**13.6**	16.9	**14.2**	**14.2**	25	**14.65**	**6.5**	**7.1**
AIW-15	25	15	25	25	25	25	25	25	25	25	25	25	22.9	25
AIW-16	25	15	23.7	25	25	25	25	25	25	23.5	20.6	23.3	20.1	22.8
AIW-17	25	14	19.2	21.1	23.7	24.3	25	24.5	23.2	19.8	16.3	18.2	16.3	17.7
AIW-18	25	15	17.5	21	22.8	22.1	21.7	22.1	21.4	17.1	16.1	17.1	**14.2**	17
AIW-19	25	15	17.7	20.6	22.25	21.4	21.1	22.2	22.5	17.9	16.4	17.15	**14.6**	17.1
AIW-20	28	18	28	28	28	28	28	28	28	27.6	28	25.8	22.4	28.2
AIW-21	28	18	**12.6**	**15**	**12.9**	**14.2**	**13.5**	**14**	**14.8**	**13.5**	**13.7**	**12**	**11**	**12.7**

NR = not recorded because system down March 21, 1997 to April 15, 1997 with electrical problems.
Bolded value indicates water level is at or above the top of the screen.
TOC = top of casing.

14.0 NOSE DOCK AREA #4

14.1 OPERATIONS

COE installed the 8 NDA biovent systems in OU 5 during the fall of 1996 and initiated system startup in October and November. The COE biovent removal action report for these systems presents relevant data. BEI began formal O&M on December 1, 1996. Since BEI assumed responsibility for O&M, the NDA-4 system had operated 527 days through June 30, 1998. The entire system was shut down during October and November 1997 because nearby construction had damaged the air hoses. NDA-4 and NDA-5 were connected together on January 19, 1998 under the blower located at NDA-5.

14.2 CONCLUSIONS AND RECOMMENDATIONS

Approximately half of the 36 AIWs averaged 0 scfm throughout the reporting period (Table 14-1). After a year and a half of operation, the western boundary and northeast arm have not accepted air or have accepted air at a low unmeasurable rate (see Figure 11-1). AIWs located in the east side of the western arm and the area just east of the support building accepted air typically below the design rate for portions of the reporting period, a reduction when compared to typical 1997 flows. As shown on Figure 11-1, elevated groundwater levels in the AIWs were common during the reporting period, but only a few wells were fully inundated (i.e., AIW 4-2, 4-4, 4-11, 4-23, 4-24, and 4-25). Saturated conditions are shown along the AIW east arm groundwater cross section presented on Figure 11-1. Figures 14-1 and 14-2 includes graphs that illustrate the fluctuating groundwater and air flow at all wells along the cross section. Table 14-2 provides 1998 groundwater levels at each AIW.

Due to wet conditions in May and June, no MPs produced soil gas samples. Only the oxygen sensor at MP 4-6 provided oxygen data (see Table 14-1). Respiration tests could not be performed at any NDA-4 MPs due to high water levels and saturated soils. Petroleum odor was noted in the deep (16 ft bgs) zone at MP 4-1. Confirmation sampling will be performed during the summer of 1998.

Overall Recommendation for NDA-4: Bioventing should continue until confirmation sampling is complete. The confirmation soil sampling data should be evaluated as soon as it becomes available. If contamination does exist, additional MPs should be installed and the system left running for another 6 to 12 months. Ex situ bioventing is another remedial alternative.

Table 14-1 NDA-4 Air Flow and Monitoring Point Data

Air Injection Well	Screen Interval top[1]	Screen Interval bottom[1]	Overburden Pressure[2] (psi)	Design Air Flow (scfm)	Individual Well Head Flow (scfm) January 1998	February 1998	March 1998	April 1998	May 1998	June 1998	Average Jan - Jun
AIW-1	14	24	9.7	10	9	9	10	9	5	10	8.7
AIW-2	8	18	5.6	9	0	0	0	0	0	0	0.0
AIW-3	6	16	4.2	9	7	0	0	9	4	7	4.5
AIW-4	11	21	7.6	9	0	5	0	0	off	off	1.3
AIW-5	11	21	7.6	9	9	9	9	0	0	0	4.5
AIW-6	8	18	5.6	9	8	5	7	8	4	7	6.5
AIW-7	11	21	7.6	9	8	6	7	0	0	0	3.5
AIW-8	9	19	6.3	9	0	0	0	0	0	0	0.0
AIW-9	8	18	5.6	9	4	0	0	0	1	off	1.0
AIW-10	8	18	5.6	9	0	0	0	0	0	off	0.0
AIW-11	7	17	4.9	8	3	0	0	0	off	off	0.8
AIW-12	6	12	4.2	5	4	2	0	5	off	off	2.8
AIW-13	6	12	4.2	5	0	0	0	0	0	3	0.5
AIW-14	6	13	4.2	5	4	0	0	0	0	0	0.7
AIW-15	6	11	4.2	4	5	4	0	0	0	off	1.8
AIW-16	6	12	4.2	5	4	0	0	0	5	5	2.3
AIW-17	6	11	4.2	4	0	0	0	0	0	4	0.7
AIW-18	6	12	4.2	5	0	0	0	0	0	0	0.0
AIW-19	6	12	4.2	5	0	0	0	0	0	0	0.0
AIW-20	16	26	11.1	11	0	0	0	0	0	0	0.0
AIW-21	12	22	8.3	11	0	0	0	0	0.5	0	0.1
AIW-22	15	25	10.4	10	0	0	0	0	0	0	0.0
AIW-23	15	25	10.4	10	0	0	0	0	0	0	0.0
AIW-24	15	25	10.4	10	0	0	0	0	0	0	0.0
AIW-25	15	25	10.4	10	0	0	0	0	0	0	0.0
AIW-26	7	15	4.9	10	0	10	0	3	2	3	3.0
AIW-27	6	14	4.2	6	0	0	0	0	0	0	0.0
AIW-28	8	16	5.6	7	0	0	0	0	0	0	0.0
AIW-29	6	14	4.2	6	6	0	6	6	6	6	5.0
AIW-30	6	13	4.2	5	5	0	0	0	off	off	1.3
AIW-31	6	13	4.2	5	5	2	0	3	5	5	3.3
AIW-32	12	22	8.3	5	0	0	0	0	0	0	0.0
AIW-33	16	26	11.1	5	0	0	0	0	0	0	0.0
AIW-34	16	26	11.1	5	0	0	0	0	0	0	0.0
AIW-35	16	26	11.1	5	0	0	0	0	0	0	0.0
AIW-36	5	8	3.5	5	7	0	0	0	7	8.5	3.8
Total air flow:				263	88.0	52.0	39.0	43.0	39.5	56.5	
Pressure (psi):					2.6	1.5	2.4	2.3	2.7	2.8	

Monitoring Point	Screen Interval top	Screen Interval bottom		Soil Gas Sampling Results January 1998 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	February 1998 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	March 1998 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	April 1998 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	May 1998 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	June 1998 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)
MP 4-1-7.0	6.5	7		No Soil Gas			No Soil Gas			No Soil Gas			No Soil Gas			water			water		
MP 4-1-16.0	15.5	16		Samples Collected			Samples Collected			Samples Collected			Samples Collected			water			water		
MP 4-2BG-5.0	5	10		due to Winter Conditions			due to Winter Conditions			due to Winter Conditions			due to Winter Conditions			water			water		
MP 4-3-4.0	3.5	4														water			water		
MP 4-4-10.0	9.5	10														no flow			water		
MP 4-5-5.0	4.5	5														no flow			no flow		
MP 4-6-15	15	15	O_2 Sensor	18.0	na	na	18.3	na	na	18.5	na	na	malf	na	na	malf	na	na	malf	na	na
MP 4-7-8.0	7.5	8														no flow			water		
MP 4-7-15.0	14.5	15														water			no flow		
MP 4-8-8.0	7.5	8														no flow			water		
MP 4-8-15.0	14.5	15														no flow			water		
MP 4-9-8.5	8	8.5														no flow			water		
MP 4-9-16.0	15.5	16														no flow			no flow		
MP 4-10-8.0	7.5	8														no flow			water		
MP4-10-15.0	14.5	15														no flow			no flow		

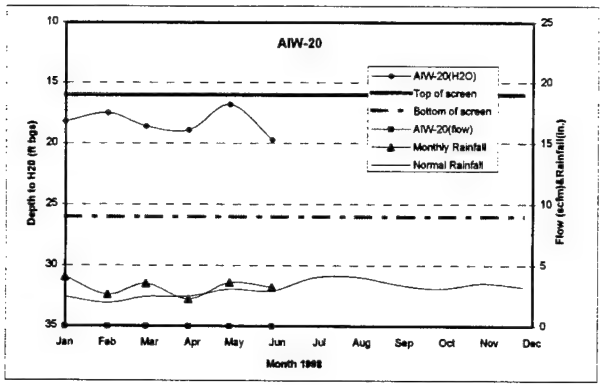
[1] Measured from top of casing.

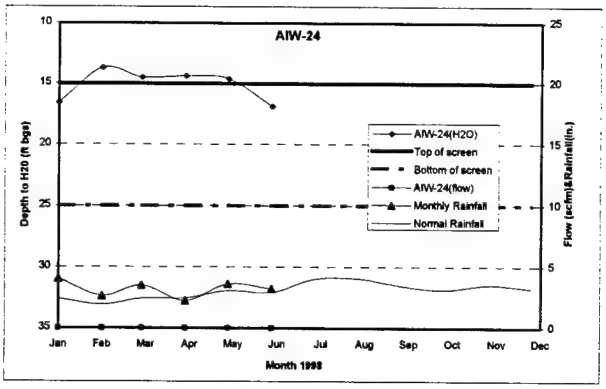
[2] Maximum pressure before potential for fracturing of soil. Calculated at top of screen assuming density of soil is 100 lbs/ft^3.

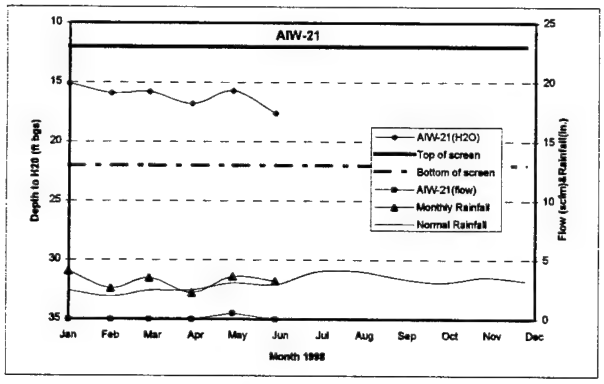
[3] O_2 result represents daily average for month.

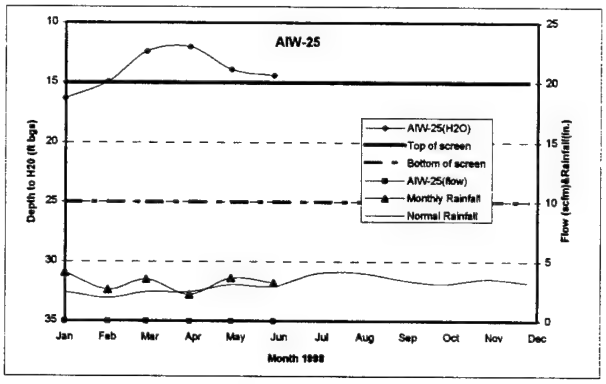
na = not applicable

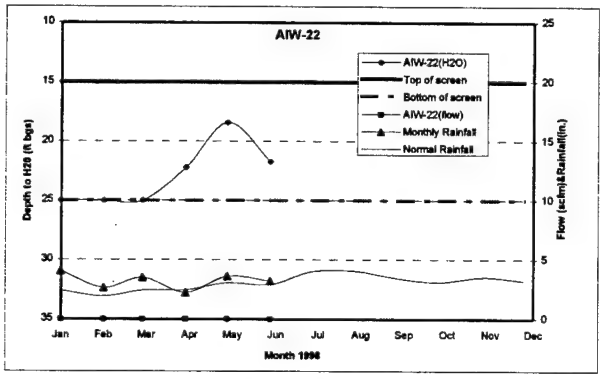
NOTE: AIW's that are noted to be "off" have been shutdown due to well seal leaks.

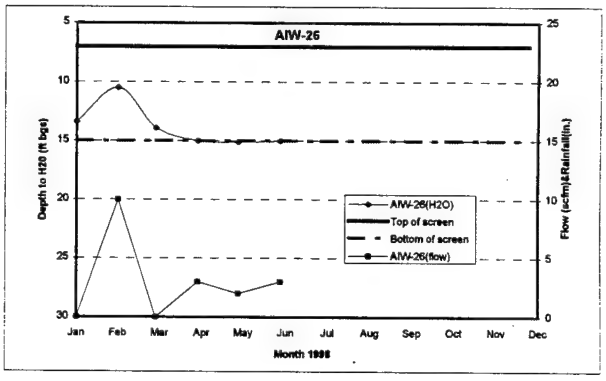


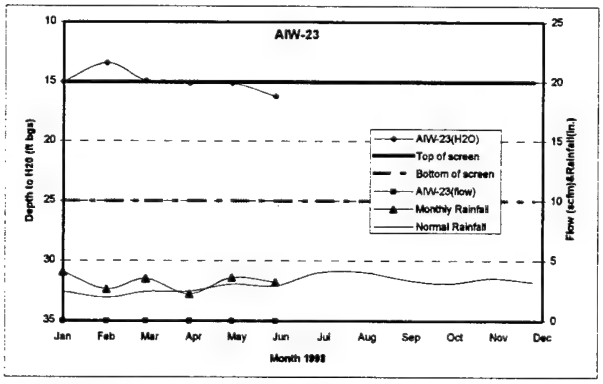


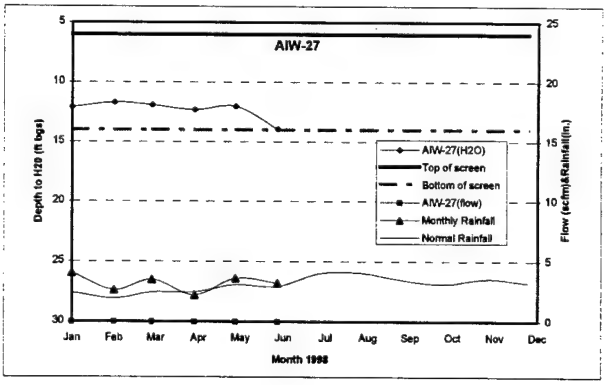






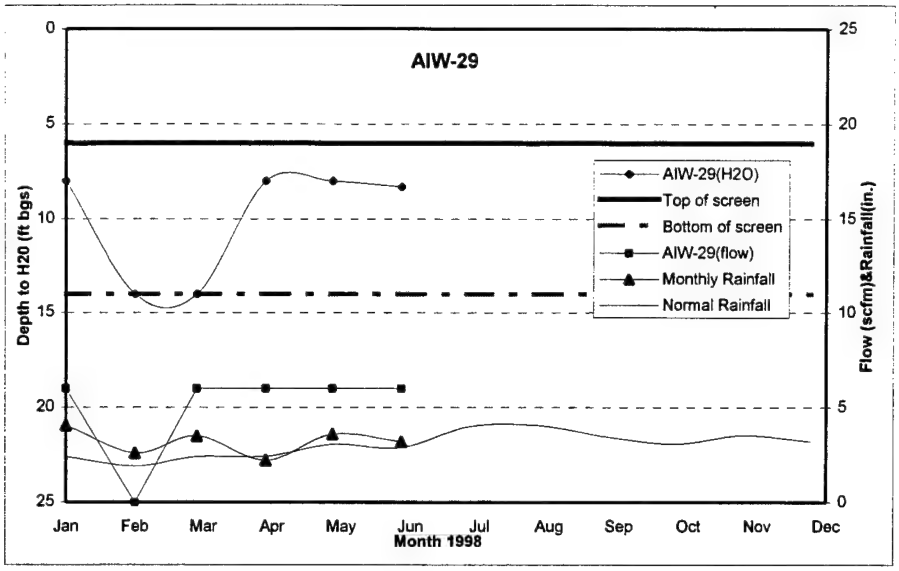


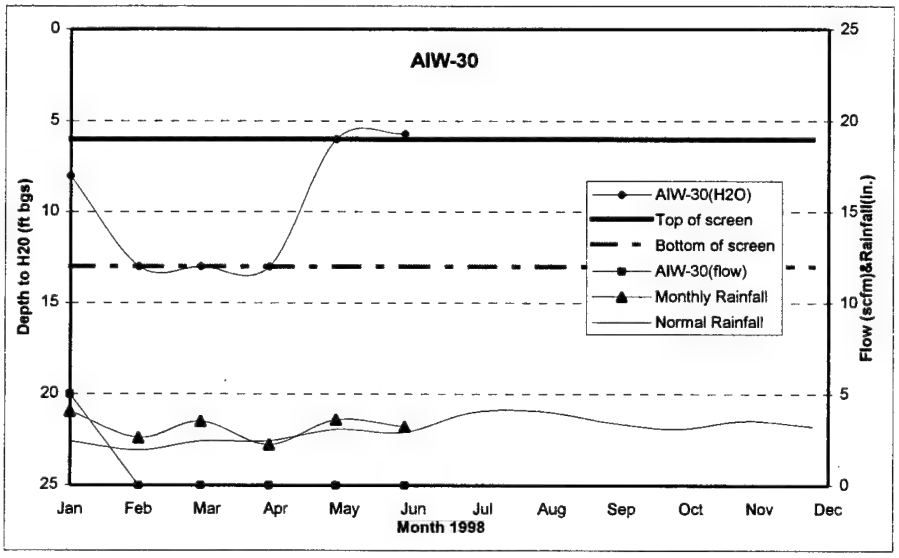


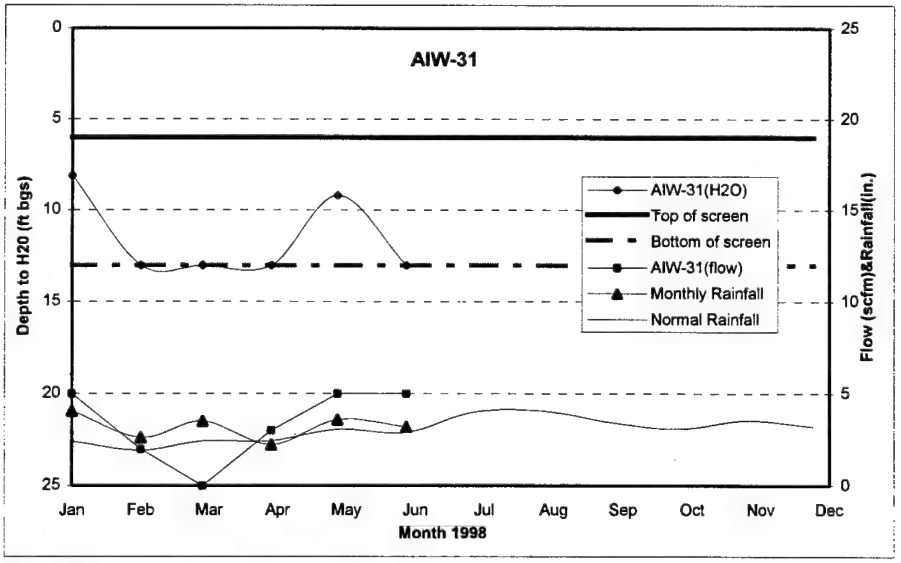


See Figure 11-1 for transect location.

Figure 14-1 Air Flow vs. Depth to Groundwater at NDA-4







See Figure 11-1 for transect location.

Figure 14-2 Air Flow vs. Depth to Groundwater at NDA-4

Table 14-2 NDA-4 Groundwater Level Data

WELL NO	Well Depth below TOC (ft)	Top of Screen below TOC (ft)	Groundwater Depth Below TOC (ft)											
			Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Apr-98	May-98	Jun-98
AIW-1	24	14	22.2	24	24	NR	NR	24	24	24	24	21.6	16.7	19.2
AIW-2	18	8	13.2	17.5	18	NR	NR	16.2	11.2	4.2	8	15.4	7.4	16.45
AIW-3	16	6	11	14.3	14.5	NR	NR	14.2	8.4	12.2	16	4.1	11.9	14.2
AIW-4	21	11	9.8	12.4	10.35	NR	NR	15.1	10.2	12	7.5	7.1	5.5	4.4
AIW-5	21	11	17.3	21	19.2	NR	NR	21	19.9	21	21	21	12.9	14.3
AIW-6	18	8	18	18	18	NR	NR	18	18	18	18	18	18	18
AIW-7	21	11	20.6	20.8	21	NR	NR	21	21	21	21	21	18.6	20.75
AIW-8	19	9	19	19	19	NR	NR	21.8	19.6	19	19	19	19	19
AIW-9	18	8	18	18	12.2	NR	NR	9.2	12.6	6.1	18	18	9.2	8.3
AIW-10	18	8	12.4	16.3	17.7	NR	NR	15.9	13.4	16.5	18	18	14.5	10.45
AIW-11	17	7	12.3	13.8	6.6	NR	NR	13.3	12.4	5.4	7.5	8.5	9.9	7
AIW-12	12	6	5.5	8.5	9.2	NR	NR	12	12	12	11.3	8.1	6.5	6.1
AIW-13	12	6	8	8.7	9.9	NR	NR	12	8.1	6.3	7	12	6.9	8.3
AIW-14	13	6	10.3	13	13.7	NR	NR	11.1	11.6	11.5	9	13	9.9	10.7
AIW-15	11	6	8.9	10.2	10.1	NR	NR	9.5	9.3	7.7	11	7.1	8.4	4.6
AIW-16	12	6	7.9	7.6	7.2	NR	NR	8.7	8.2	5.3	6.4	6.2	8	5.9
AIW-17	11	6	7.6	9	7.2	NR	NR	8.6	8.1	7.8	11	11	5.5	8.8
AIW-18	12	6	8.7	10.7	9.5	NR	NR	10.5	9.7	8.4	7.4	7.3	7.9	10
AIW-19	12	6	9	11.5	11.4	NR	NR	10.9	9.3	9.1	7.6	7.8	7.6	10.4
AIW-20	26	16	17	17.6	17.9	NR	NR	18.3	18.2	17.5	18.6	18.9	16.8	19.7
AIW-21	22	12	16.2	17.5	18.2	NR	NR	17.8	15.1	15.9	15.8	16.8	15.7	17.6
AIW-22	25	15	23.3	25.8	25	NR	NR	25	25	25	25	22.2	18.4	21.7
AIW-23	25	15	15	14.5	14.9	NR	NR	14	15	13.4	14.9	15.1	15.1	16.2
AIW-24	25	15	13.8	15.5	16.3	NR	NR	14.1	16.6	13.7	14.5	14.4	14.6	16.9
AIW-25	25	15	13.8	16	15.7	NR	NR	16.1	16.3	14.9	12.4	12	13.9	14.4
AIW-26	15	7	10.7	11.9	9.5	NR	NR	13.9	13.4	10.5	13.9	15	15.1	15
AIW-27	14	6	12.4	13.3	13	NR	NR	13.7	12.1	11.7	11.9	12.3	12	13.9
AIW-28	16	8	12.5	14	12.6	NR	NR	13.6	11.9	16	16	16	12.1	13.4
AIW-29	14	6	7.8	5.8	6.2	NR	NR	14	8	14	14	8	8	8.3
AIW-30	13	6	7.8	6.7	6.1	NR	NR	7.1	8	13	13	13	6	5.7
AIW-31	13	6	8.5	7.8	7.5	NR	NR	8.2	8.1	13	13	13	9.2	13
AIW-32	22	12	22	22	22	NR	NR	22	18.6	22	22	22	22	22
AIW-33	26	16	22	23.3	26	NR	NR	26	26	26	26	22.1	19.9	22.6
AIW-34	26	16	21.8	22.7	25	NR	NR	26	26	26	26	21.8	19.9	21.6
AIW-35	26	16	21.6	22.6	23.9	NR	NR	24.9	25.3	26	26	20.9	19.5	21.6
AIW-36	8	5	6.3	5.9	5.9	NR	NR	8	8	8	8	8	8	8

Bolded value indicates water level is at or above the top of the screen.
NR = not recorded because system down October and November due to construction in area.
TOC = top of casing.

15.0 NOSE DOCK AREA #5

15.1 OPERATIONS

COE installed the 8 NDA biovent systems in OU 5 during the fall of 1996 and initiated system startup in October and November. The COE biovent removal action report for these systems presents relevant data. BEI began formal O&M on December 1, 1996. Since BEI assumed responsibility for O&M, the NDA-5 system had operated 526 days through June 30, 1998. The entire system was shut down during October and November 1997 because nearby construction had damaged the air hoses. NDA-4 and NDA-5 were connected together on January 19, 1998 under the blower located at NDA-5.

15.2 CONCLUSIONS AND RECOMMENDATIONS

AIWs accepting air during the reporting period were typically either at zero flow or close to the design rate (Table 15-1). AIWs 5-2, 5-5, and 5-20 have not accepted air since startup in December 1996. AIWs-5-6, 5-8, 5-10, and 5-21 were essentially ineffective during the reporting period. Since these wells are scattered throughout NDA-5, there are no significant areas not receiving air. Table 15-2 provides 1998 AIW groundwater levels. Partially saturated AIWs were predominantly located in the northern end of NDA-5, in close proximity to NDA-4 (i.e., AIWs-5-6, 5-7, and 5-9). Figures 15-1 and 15-2 includes graphs that illustrate the fluctuating groundwater levels and air flow at all wells along the cross section identified in Figure 11-1.

MP 5-4 was the only MP sampled during April and May due to the saturated conditions of the soils. The oxygen sensor malfunctioned each month and is planned to be replaced. No respiration tests were performed due to a high oxygen level in MP 5-4 and saturated conditions in all other MPs. Confirmation sampling will be performed during the summer of 1998.

Overall Recommendation for NDA-5: Bioventing should continue until confirmation sampling is complete. The confirmation soil sampling data should be evaluated as soon as it becomes available. If contamination does exist, additional MPs should be installed and the system left running for another 6 to 12 months. Ex situ bioventing is another remedial alternative.

Table 15-1 NDA-5 Air Flow and Monitoring Point Data

Air Injection Well	Screen Interval top[1]	Screen Interval bottom[1]	Overburden Pressure[2] (psi)	Design Air Flow (scfm)	Individual Well Head Flow (scfm) January 1998	February 1998	March 1998	April 1998	May 1998	June 1998	Average Jan - Jun
AIW-1	5	8	3.5	9	7.5	0	2	3	5	8	4.3
AIW-2	5	8	3.5	9	0	0	0	0	0	0	0.0
AIW-3	8	9	4.2	9	9	9	0	6	0	2	4.3
AIW-4	6	11	4.2	5	5	0	0	3	2	5	2.5
AIW-5	8	14	5.6	6	0	0	0	0	0	0	0.0
AIW-6	7	13	4.9	6	off	0	0	0	3	off	0.8
AIW-7	7	13	4.9	6	6	0	0	0	1	6	2.2
AIW-8	7	13	4.9	6	6	0	0	0	0	6	2.0
AIW-9	7	13	4.9	7	7	7	6	5	6	0	5.2
AIW-10	7	13	4.9	7	7	0	0	0	off	off	1.8
AIW-11	6	12	4.2	6	6	6	6	6	6	6	6.0
AIW-12	7	13	4.9	7	7	0	0	2	2	3.5	2.4
AIW-13	6	11	4.2	6	6	6	6	6	6	6	6.0
AIW-14	6	11	4.2	6	6	6	0	3	off	off	3.8
AIW-15	6	10	4.2	7	7	3	7	5	6.5	6.5	5.8
AIW-16	6	10	4.2	7	7	7	7	7	7	7	7.0
AIW-17	6	11	4.2	7	7	7	7	7	off	off	7.0
AIW-18	6	10	4.2	7	7	7	7	7	7	7	7.0
AIW-19	6	10	4.2	7	7	7	7	7	7	7	7.0
AIW-20	6	10	4.2	7	0	0	0	0	0	0	0.0
AIW-21	6	9	4.2	6	0	0	0	0	0	0	0.0
AIW-22	6	10	4.2	7	7	7	7	7	7	7	7.0
AIW-23	6	11	4.2	6	6	4	2	3	off	off	3.8
AIW-24	5	8	3.5	6	5	6	5	6	6	off	5.6
AIW-25	6	9	4.2	6	6	5	6	3	off	off	5.0
AIW-26	5	8	3.5	6	6	6	6	6	6	6	6.0
AIW-27	4	7	2.8	5	off	5	5	3	1	5	3.8
AIW-28	4	7	2.8	5	5	5	5	5	off	off	5.0
AIW-29	4	6	2.8	5	5	5	4	2.5	0	off	3.3
Total air flow:				189	147.5	108.0	95.0	102.5	78.5	88.0	
Pressure (psi):					2.8	1.5	2.4	2.3	2.7	2.8	

Monitoring Point	Screen Interval (ft bgs) top	bottom		Soil Gas Sampling Results January 1998 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	February 1998 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	March 1998 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	April 1998 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	May 1998 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	June 1998 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)
MP 5-1-9.5	9.5	10															water			water	
MP 5-2-3.5	3.5	4															no flow			water	
MP 5-3-7	7	7	O_2 Sensor[4]	19.0	na	na	Malfunction			Malfunction			Malfunction				Malfunction			Malfunction	
MP 5-4-7.0	7	7.5														20.4	0.0	11.7	19.8	3.0	3.8
MP 5-5-7.0	7	7.5		No Soil Gas Samples Collected due to Winter Conditions			No Soil Gas Samples Collected due to Winter Conditions			No Soil Gas Samples Collected due to Winter Conditions			No Soil Gas Samples Collected due to Winter Conditions				no flow			water	
MP 5-6-5.5	5.5	6															no flow			water	
MP 5-8-3.0	3	3.5															water			water	

[1] Measured from top of casing.

[2] Maximum pressure before potential for fracturing of soil. Calculated at top of screen assuming density of soil is 100 lbs/ft^3.

[3] O_2 result represents daily average for month.

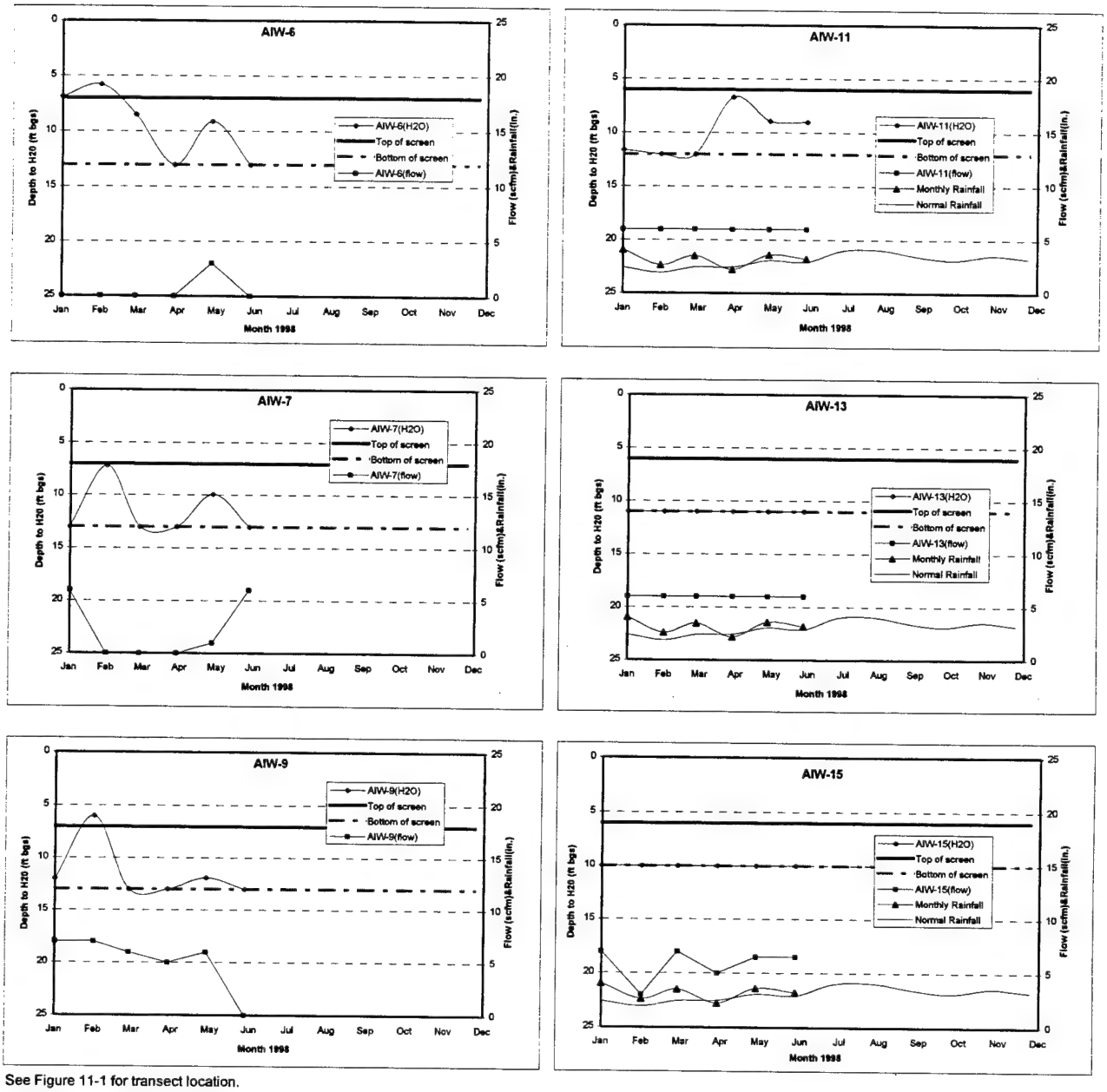
nr = no reading

NOTE: AIW's that are noted to be "off" have been shutdown due to well seal leaks.

Table 15-2 NDA-5 Groundwater Level Data

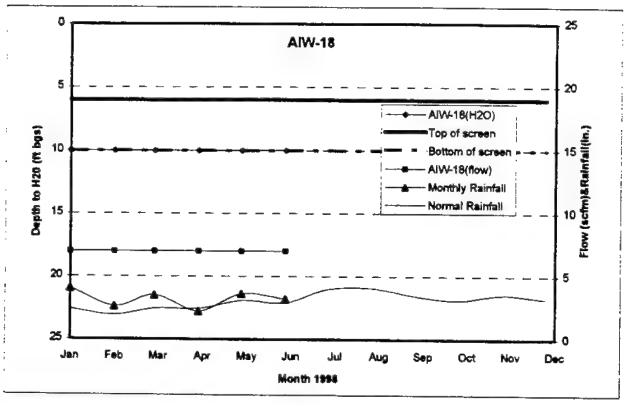
WELL NO	Well Depth below TOC (ft)	Top of Screen below TOC (ft)	Groundwater Depth Below TOC (ft)											
			Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Apr-98	May-98	Jun-98
AIW-1	8	5	7.3	8	8	NR	NR	8	8	5.3	7.3	8.5	8	8
AIW-2	8	5	8	8	8	NR	NR	8	8	8	8	8	8	8
AIW-3	9	6	8.8	9	9	NR	NR	9	9	7.9	9	6.9	7.9	9
AIW-4	11	6	8.6	11	8.3	NR	NR	11	11	11	8.1	11	8.5	9.3
AIW-5	14	8	8.7	13.3	13.9	NR	NR	12.1	14	12.7	7.4	9.4	8.6	11.7
AIW-6	13	7	10.6	**7.1**	**6.4**	NR	NR	13	**6.9**	**5.8**	8.5	13	9.1	13
AIW-7	13	7	9.3	13	13	NR	NR	13	13	7.2	13	13	9.9	13
AIW-8	13	7	11	11.9	13	NR	NR	11.6	12.1	11.5	11.6	11.6	10.7	13
AIW-9	13	7	10.9	12	13.9	NR	NR	11.4	12	**6**	13	13	11.9	13
AIW-10	13	7	7.8	11.7	13	NR	NR	11.2	11.9	**5**	nt	13	7.5	5.4
AIW-11	12	6	8.5	10.4	9.2	NR	NR	9.7	11.6	12	12	6.7	8.9	9
AIW-12	13	7	10.4	13	13	NR	NR	13	10.9	**6.6**	**6.9**	8.8	10	13
AIW-13	11	6	11	11	11	NR	NR	11	11	11	11	11	11	11
AIW-14	11	6	10.6	11	11.3	NR	NR	11	10.8	6.8	8.4	7	**5.4**	**5.4**
AIW-15	10	6	10	10	10	NR	NR	10	10	10	10	10	10	10
AIW-16	10	6	10	10	10	NR	NR	10	10	10	10	10	10	10
AIW-17	11	6	8.7	9.5	11	NR	NR	9.4	9.6	8.3	11	7.1	8.6	8.6
AIW-18	10	6	10	10	10	NR	NR	10	10	10	10	10	10	10
AIW-19	10	6	10	10	10	NR	NR	10	10	10	8.7	10	10	10
AIW-20	10	6	9.3	10	10	NR	NR	10	10	9.9	8.7	10	10	9
AIW-21	9	6	9	9	9	NR	NR	9	9	9	9	9	9	10
AIW-22	10	6	10	10	10	NR	NR	10	10	10	10	10	10	11
AIW-23	11	6	8.3	11	11	NR	NR	11	11	11	9.6	11	7.5	7.7
AIW-24	8	5	8	8	8	NR	NR	8	8	8	8	8	8	8
AIW-25	9	6	9	9	9	NR	NR	9	9	9	9	9	7.4	7.1
AIW-26	8	5	8	8	8	NR	NR	8	8	8	8	8	8	8
AIW-27	7	4	7	7	7	NR	NR	7	7	7	5.6	7	5.5	7
AIW-28	7	4	7	7	7	NR	NR	7	7	7	7	7	6.6	6.3
AIW-29	6	4	5.7	6	6	NR	NR	6	6	6	5	6	6	6

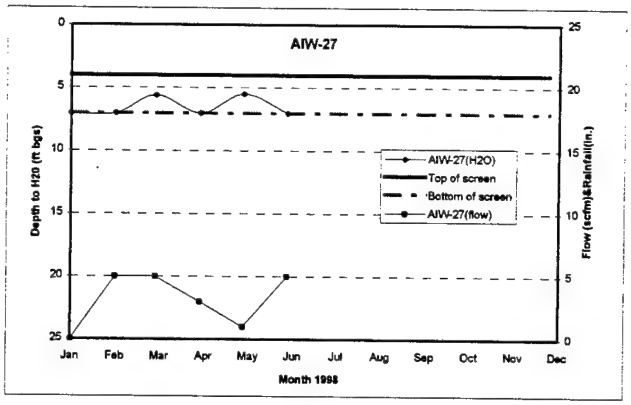
Bolded value indicates water level is at or above the top of the screen.
TOC = top of casing.

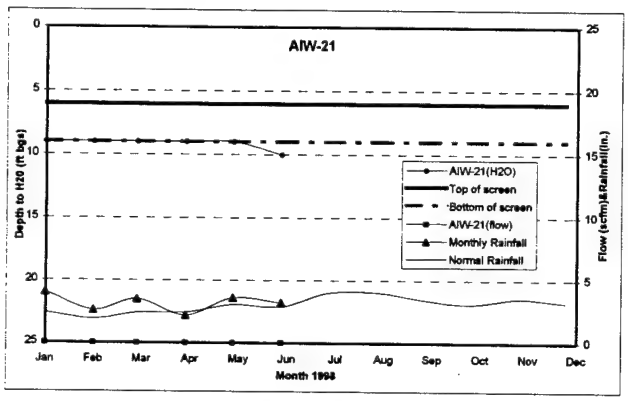


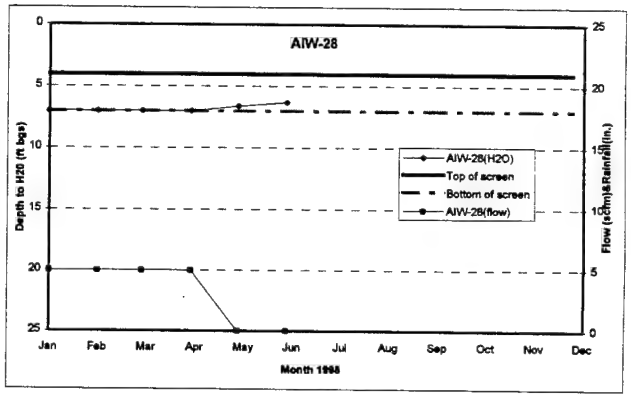
See Figure 11-1 for transect location.

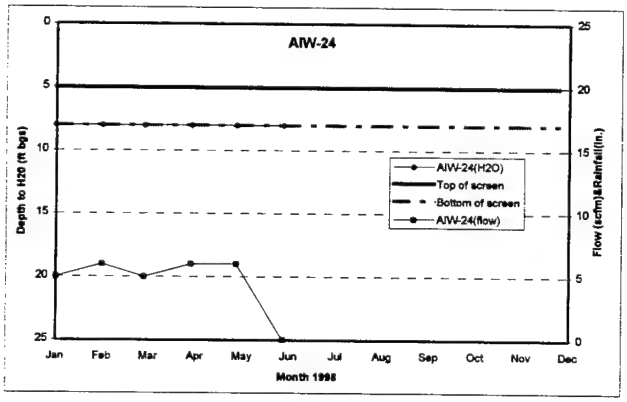
Figure 15-1 Air Flow vs. Depth to Groundwater at NDA-5











NOTE: See Figure 11-1 for transect location.

Figure 15-2 Air Flow vs. Depth to Groundwater at NDA-5

16.0 NOSE DOCK AREA #6

16.1 OPERATIONS

COE installed the 8 NDA biovent systems in OU 5 during the fall of 1996 and initiated system startup in October and November. The COE biovent removal action report for these systems presents relevant data. BEI began formal O&M on December 1, 1996. Since BEI assumed responsibility for O&M, the NDA-6 system had operated 609 days through June 30, 1998. A new oxygen sensor (MP-6-4-5.5) was installed near AIW-6-2 (Figure 11-1, foldout) on July 29, 1997.

16.2 CONCLUSIONS AND RECOMMENDATIONS

Only one of the four AIWs is operating (AIW-2); the other three were turned off at the request of researchers at the University of Maine at Orono (Table 16-1). Currently, a graduate student writing a master's thesis on bioventing has been granted use of NDA-6 for research purposes. Operation, therefore, is conducted in conjunction with research activities at the site. No modifications are anticipated to occur to this system. Monthly air flow readings and MP data are presented on Table 16-1. AIW-6-2 operated close to design through this reporting period. Water levels for the AIWs are presented on Table 16-2. AIW-6-1 and 6-3 were inundated with water during the majority of the reporting period.

A respiration test was performed at MP-6-2BG in June. The oxygen utilization rate was determined to be 0.1 percent/hour, which is representative of background levels (Figure A-20). The new oxygen sensor added to NDA-6 produced monthly oxygen readings of 19.1, 16.3, 17.3, and 16.9 percent from October through December 1997. Oxygen levels noted in January, February, and March were 3.7, 4.5, and 1.4, respectively. There is no explanation for the dramatic decline in oxygen concentrations. Fuel has been noted previously in MPs installed by the research student in the area of AIW-6-2. These new levels are indicative of biodegradation. As noted in the last semiannual report, the background location appears to be within contaminated soils; the oxygen levels are unusually low (11.5 and 12.9 percent). No volatiles were noted, and carbon dioxide levels are relatively low. It is possible that these concentrations may be indicative of background since the respiration test indicates that an oxygen utilization rate similar to background conditions exist. Confirmation sampling will be performed during the summer of 1998.

Overall Recommendation for NDA-6: It is recommended to return all AIWs to operation as soon as possible. Confirmation soil samples collected throughout NDA-6 should be evaluated. If AIWs 6-1, 6-3, and 6-4 are ineffective and residual contamination is found, the site may be excavated.

Table 16-1 NDA-6 Air Flow and Monitoring Point Data

Air Injection Well	Screen Interval top[1]	Screen Interval bottom[1]	Overburden Pressure[2] (psi)	Design Air Flow (scfm)	Individual Well Head Flow (scfm) January 1998	February 1998	March 1998	April 1998	May 1998	June 1998	Average Jan - Jun
AIW-1	8	18	5.6	7	off	off	off	off	off	off	
AIW-2	8	18	5.6	7	7	7	5	0	5	5	7
AIW-3	8	18	5.6	7	off	off	off	off	off	off	
AIW-4	8	18	5.6	7	off	off	off	off	off	off	
Total air flow:				28	7.0	7.0	5.0	0.0	5.0	5.0	
Pressure (psi):					2.2	2.2	2.3	2.1	1.9	2.5	

Monitoring Point	Screen Interval top	Screen Interval bottom		Soil Gas Sampling Results January 1998 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	February 1998 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	March 1998 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	April 1998 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	May 1998 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	June 1998 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)
MP 6-1-4	4	4	O_2 Sensor	3.7	na	na	4.5	na	na	1.4	na	na	Water covering sensor			Water covering sensor			Water covering sensor		
MP 6-2BG-7.0	7	12	O_2 Util. Rate = 0.10%/hr[4]	No Soil Gas Samples Collected du to Winter Conditions												14.9	1.3	0	12.3	2.4	0
MP 6-3-8	8	8.5														no flow			water		
MP 6-4-5.5	5.5	6	O_2 Sensor	14.6	na	na	12.6	na	na	12.8	na	na	13.9	na	na	15.2	na	na	15.2	na	na

[1] Measured from top of casing.

[2] Maximum pressure before potential for fracturing of soil. Calculated at top of screen assuming density of soil is 100 lbs/ft^3.

[3] O_2 result represents daily average for month.

[4] Test performed on 6/27/98.

NOTE: AIW's that are noted to be "off" have been shutdown due to well seal leaks.

Table 16-2 NDA-6 Groundwater Level Data

WELL NO	Well Depth below TOC (ft)	Top of Screen below TOC (ft)	Groundwater Depth Below TOC (ft)											
			Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Apr-98	May-98	Jun-98
AIW-1	18	8	**7.3**	**7.4**	**7.2**	**7.7**	**7.6**	**8**	7.7	7.8	6.3	4.3	4.9	5.5
AIW-2	18	8	11.6	11.8	11.55	11.6	11.3	11	10.9	11.2	9.2	7.1	10.3	11
AIW-3	18	8	**5.9**	**6.45**	**6.2**	**6.6**	8.5	8.8	10.2	9	**7.6**	**5.57**	**5.9**	**6.6**
AIW-4	18	8	9.7	10.2	11.5	11.5	11.4	11.4	11.5	11.5	11	9.9	9.8	9.8

Bolded value indicates water level is at or above the top of the screen.
TOC = top of casing.

17.0 NOSE DOCK AREA #7

17.1 OPERATIONS

COE installed the 8 NDA biovent systems in OU 5 during the fall of 1996 and initiated system startup in October and November. The COE biovent removal action report for these systems presents relevant data. BEI began formal O&M on December 1, 1996. Since BEI assumed responsibility for O&M, the NDA-7 system had operated 605 days through June 30, 1998.

17.2 CONCLUSIONS AND RECOMMENDATIONS

Table 17-1 presents the flow at each of the four AIWs since startup. No samples have been collected from MP 7-1 since startup due to no flow or saturated conditions. Oxygen data was collected each month from oxygen sensor MP 7-2 (Table 17-1).

All four AIWs have been partially inundated with groundwater from January through June (Figure 17-1). It appears that AIW-7-1 and 7-4 remain ineffective. Table 17-2 contains the depths to groundwater at each of the four AIWs. Only AIW-7-2 accepted air during the entire 6 months. AIW-7-3 accepted air in all months except May and June. Confirmation sampling will be performed during the summer of 1998.

Overall Recommendation for NDA-7: The 1998 confirmation soil sample results should be evaluated to advise status of continued bioventing or alternative remediation.

Table 17-1 NDA-7 Air Flow and Monitoring Point Data

Air Injection Well	Screen Interval top[1]	Screen Interval bottom[1]	Overburden Pressure[2] (psi)	Design Air Flow (scfm)	Individual Well Head Flow (scfm) January 1998	February 1998	March 1998	April 1998	May 1998	June 1998	Average Jan - Jun
AIW-1	6	21	4.2	9	7	0	0	0	0	0	1.2
AIW-2	6	21	4.2	9	8	9	9	9	7	9	8.5
AIW-3	6	21	4.2	9	9	9	9	5	off	0	6.4
AIW-4	6	21	4.2	9	0	0	off	0	0	0.5	0.1
Total air flow:				36	24.0	18.0	18.0	14.0	7.0	9.5	
Pressure (psi):					2.4	3.1	3.1	2.7	2.2	3.6	

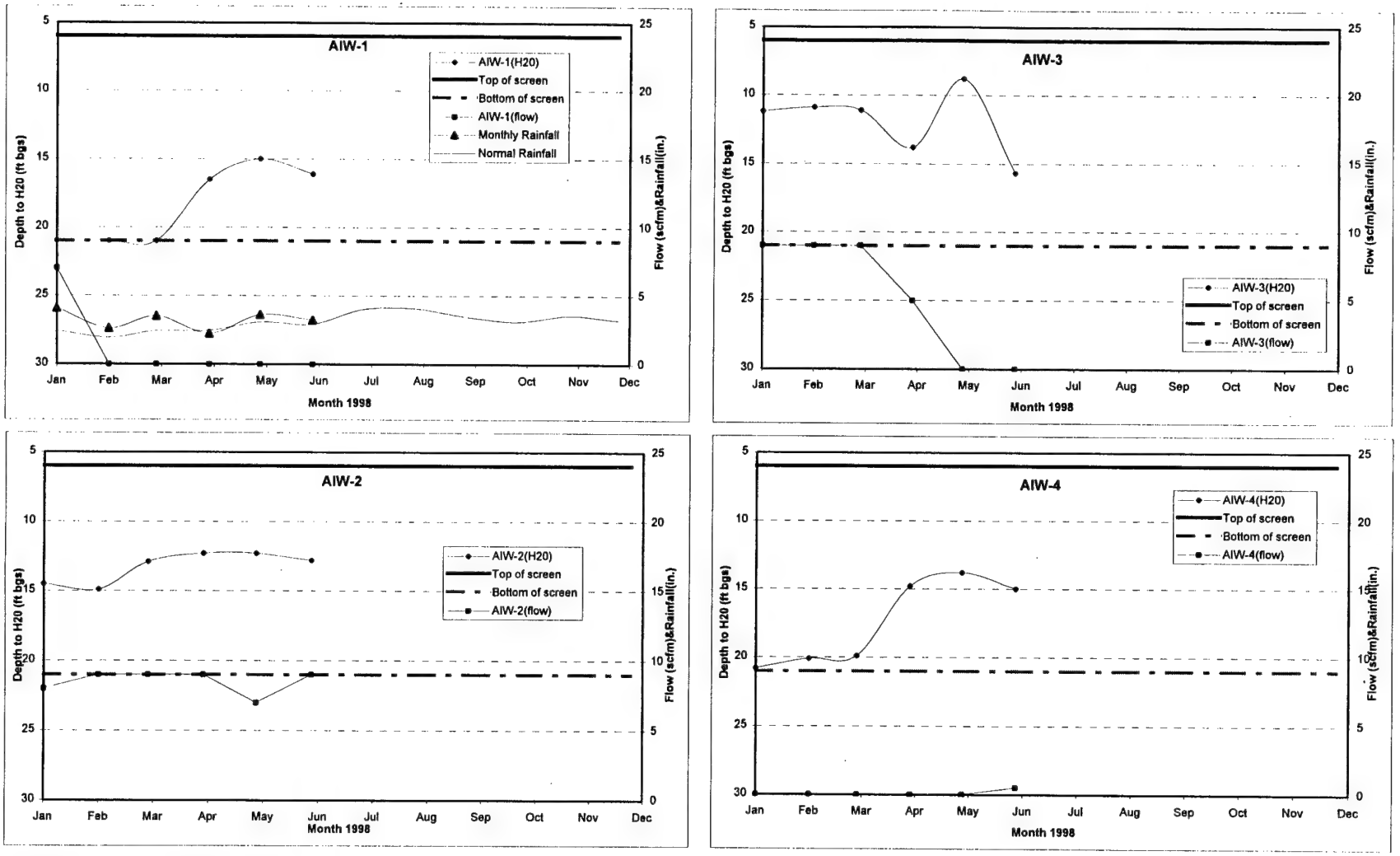
Monitoring Point	Screen Interval (ft bgs) top	bottom		Soil Gas Sampling Results January 1998 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	February 1998 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	March 1998 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	April 1998 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	May 1998 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	June 1998 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)
MP 7-1-7.0	7	7.5		No Soil Gas Samples Collected due to Winter Conditions												no flow			water		
MP 7-2-4.5	4.5	5	O_2 Sensor	14.9	na	na	15.8	na	na	16.4	na	na	17.4	na	na	18.7	na	na	19.3	na	na

[1] Measured from top of casing.

[2] Maximum pressure before potential for fracturing of soil. Calculated at top of screen assuming density of soil is 100 lbs/ft^3.

[3] O_2 result represents daily average for month.

NOTE: AIW's that are noted to be "off" have been shutdown due to well seal leaks.



See Figure 11-1 for transect location.

Figure 17-1 Air Flow vs. Depth to Groundwater at NDA-7

Table 17-2 NDA-7 Groundwater Level Data

WELL NO	Well Depth below TOC (ft)	Top of Screen below TOC (ft)	Groundwater Depth Below TOC (ft)											
			Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Apr-98	May-98	Jun-98
AIW-1	21	6	9.5	15.6	19.2	19.7	18.5	18.5	21	21	21	16.5	15	16.1
AIW-2	21	6	10	15	16.8	16.3	10.3	14.3	14.5	14.9	12.9	12.3	12.3	12.8
AIW-3	21	6	9	14.7	10.1	10.2	14.4	10.6	11.2	10.9	11.1	13.8	8.8	15.7
AIW-4	21	6	9	15.1	17.85	18.5	17.9	18.3	20.8	20.1	19.9	14.8	13.8	15

TOC = top of casing.

18.0 NOSE DOCK AREA #8

18.1 OPERATIONS

COE installed the 8 NDA biovent systems in OU 5 during the fall of 1996 and initiated system startup in October and November. The COE biovent removal action report for these systems presents relevant data. BEI began formal O&M on December 1, 1996. Since BEI assumed responsibility for O&M, the NDA-8 system had operated 611 days through June 30, 1998. Monthly air flow and MP soil gas sampling results are presented on Table 18-1.

18.2 CONCLUSIONS AND RECOMMENDATIONS

The majority of the AIWs to the north of the support building and AIWs-22 and -23 have remained ineffective and do not accept air or accept air at a low unmeasurable rate. These areas have been at zero air flow during the entire 1997 season and the first half of 1998. The total flow entering the AIWs located south of the support building has decreased from fall 1997 levels by about 50 percent. Only AIWs-8-11, 8-16, 8-17, 8-18, and 8-19 remained at design air flow rates through the reporting period. As shown on Figures 11-1, 18-1 and 18-2, the AIWs south of the support building (AIW 8-11 and above) were inundated with groundwater to levels typically greater than half of the screen from March through June. These levels were also noted in the AIWs to the north of the support building, but with a more harsh effect on air flow. It is likely that soil conditions in the north end of NDA-8 may include a thicker clay layer that may extend across the entire screened interval. Table 18-2 provides depths to groundwater in each AIW during 1998.

Oxygen levels in MPs 8-3 and 8-4 indicate that oxygen is abundant (typically greater than 18 percent), possibly at levels representing clean conditions. The June level noted in MP-8-3 (20.5 percent) was taken after the system had been shut down for more than 12 hours, which would be expected if the soils were not contaminated. MP-8-2 remains unusable, most likely within the same saturated soils that affect the ineffective AIWs. It is unclear why MP-8-4 indicates high levels of oxygen with none of the surrounding AIWs accepting air; it is possible that the soils surrounding this MP may not be contaminated.

No respiration tests were performed due to high oxygen in MP-8-3 and water in MP 8-2. Confirmation sampling will be performed during the summer of 1998.

Overall Recommendation for NDA-8: The recommendation is to evaluate another remedial technology applicable to the entire site because of the lack of air injection in the northern end and the high water levels in the southern end of NDA-8. Shallow soils (i.e., upper 10 ft) in the southern end may have been remediated. Confirmation soil sampling results will determine the extent of any remaining contamination.

Table 18-1 NDA-8 Air Flow and Monitoring Point Data

Air Injection Well	Screen Interval top[1]	Screen Interval bottom[1]	Overburden Pressure[2] (psi)	Design Air Flow (scfm)	Individual Well Head Flow (scfm) January 1998	February 1998	March 1998	April 1998	May 1998	June 1998	Average Jan - Jun
AIW-1	14	26	9.7	10	5	4.5	2	0	0	0	1.9
AIW-2	14	26	9.7	10	5	4	4	0	0	0	2.2
AIW-3	13	25	9.0	10	0	0	0	0	0	0	0.0
AIW-4	13	25	9.0	10	0	0	0	0	0	0	0.0
AIW-5	12	24	8.3	10	0	0	0	0	0	0	0.0
AIW-6	12	24	8.3	10	0	0	0	0	0	0	0.0
AIW-7	11	23	7.6	9	0	0	0	0	0	0	0.0
AIW-8	10	22	6.9	8	0	0	0	0	0	0	0.0
AIW-9	11	23	7.6	7	0	0	0	0	0	0	0.0
AIW-10	10	22	6.9	6	6	6	4.5	1	3.5	5	4.3
AIW-11	9	21	6.3	7	7	7	6.5	7	7	7	6.9
AIW-12	8	20	5.6	7	3	4	0	0	off	0.5	1.5
AIW-13	9	21	6.3	7	7	7	0	off	off	5.5	4.9
AIW-14	7	19	4.9	8	8	7.5	5	0	2.5	5	4.7
AIW-15	7	19	4.9	9	8	9	off	0	0	0	3.4
AIW-16	7	19	4.9	10	10	10	9	10	10	10	9.8
AIW-17	6	18	4.2	10	10	10	10	9	10	10	9.8
AIW-18	6	18	4.2	10	10	10	10	10	10	10	10.0
AIW-19	11	23	7.6	9	9	9	9	9	9	9	9.0
AIW-20	11	23	7.6	8	8	8	0	0	0	2	3.0
AIW-21	9	21	6.3	8	3	1	1	0	0	0	0.8
AIW-22	10	22	6.9	7	0	0	0	0	0	0	0.0
AIW-23	12	24	8.3	7	0	0	0	0	0	0	0.0
Total air flow:				197	99.0	97.0	61.0	46.0	52.0	64.0	
Pressure (psi):					3.3	3.1	3.1	2.4	2.7	3.2	

Monitoring Point (see note 4)	Screen Interval top	Screen Interval bottom	Soil Gas Sampling Results January 1998 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	February 1998 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	March 1998 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	April 1998 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	May 1998 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	June 1998 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)
MP 8-2-8.0	8	8.5	No Soil Gas Samples Collected due to Winter Conditions												no flow			water		
MP 8-3-8.0	8	8.5													20.6	0.0	0.2	20.5	0.0	0.9
MP 8-4-9.5	9.5	10 O_2 Sensor	19.1	na	na	19.5	na	na	18.4	na	na	9.0	na	na	18.5	na	na	19.0	na	na

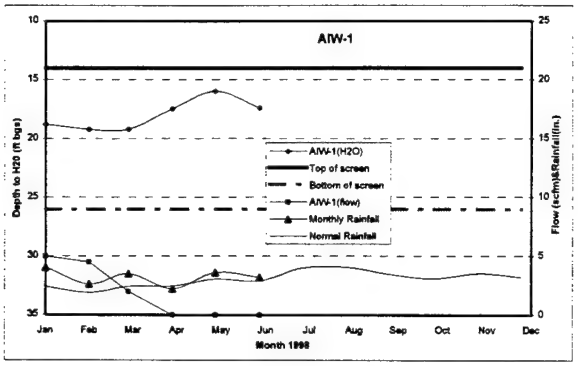
[1] Measured from top of casing.

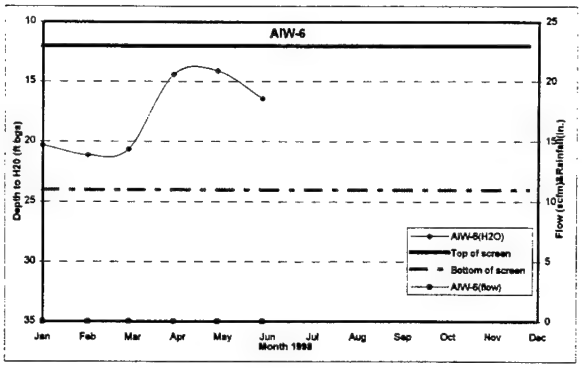
[2] Maximum pressure before potential for fracturing of soil. Calculated at top of screen assuming density of soil is 100 lbs/ft^3.

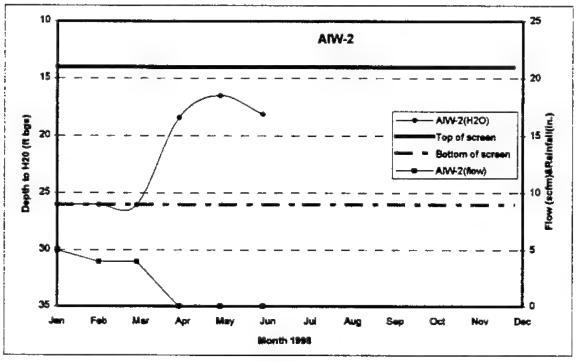
[3] O_2 result represents daily average for month.

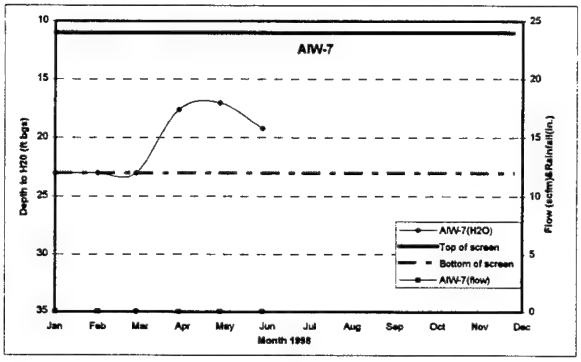
[4] MP 8-1 was not installed.

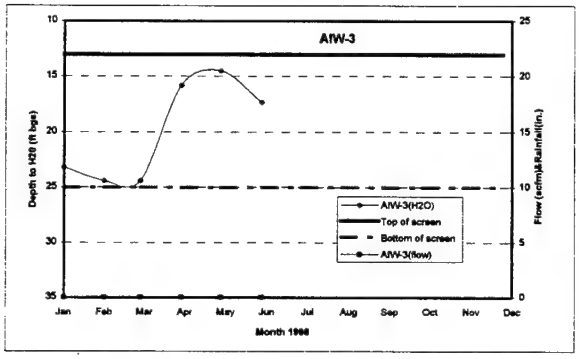
na = not applicable

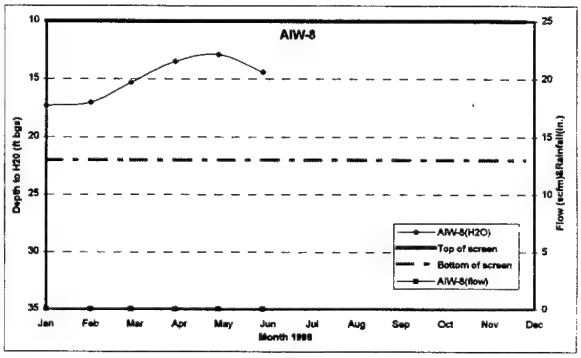


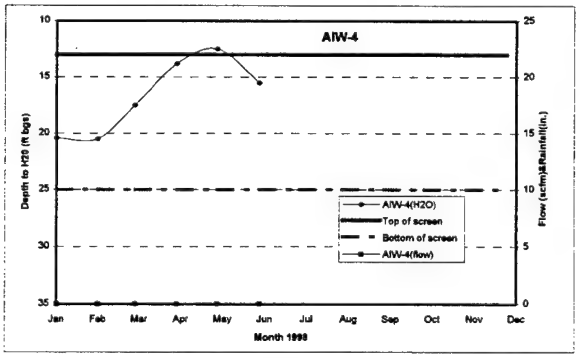


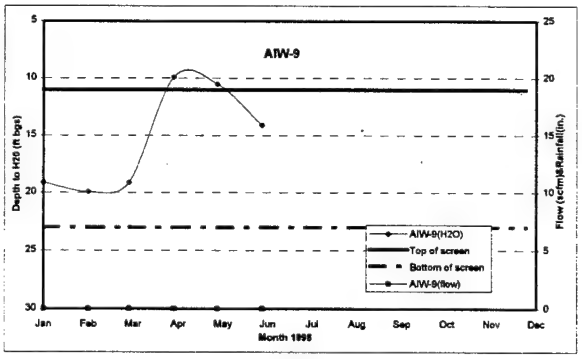


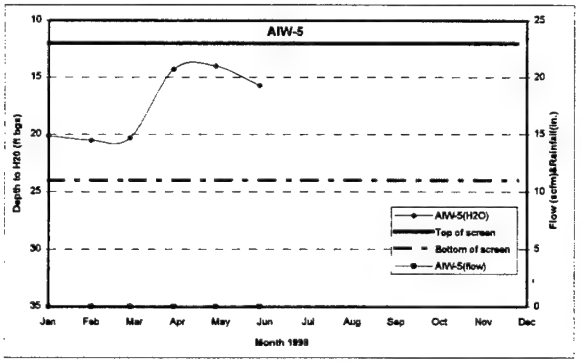












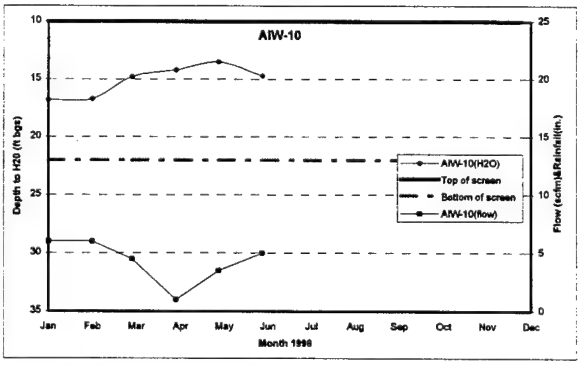
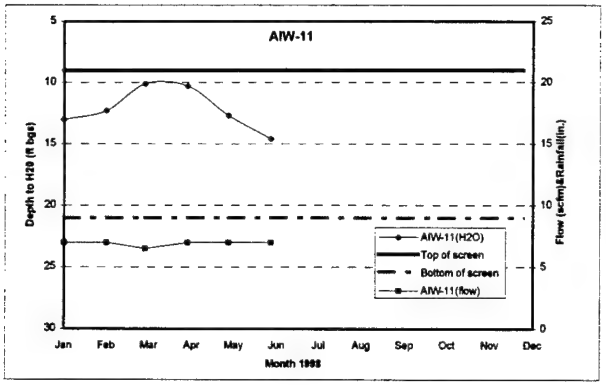
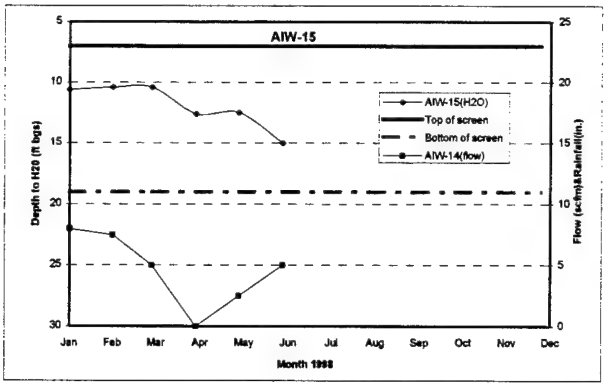


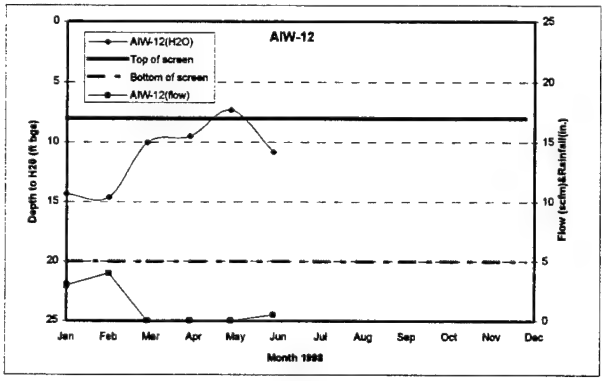
Figure 18-1 Air Flow vs. Depth to Groundwater at NDA-8

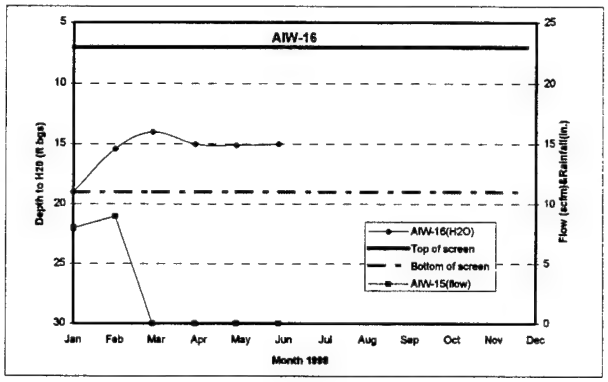
See Figure 11-1 for transect location.

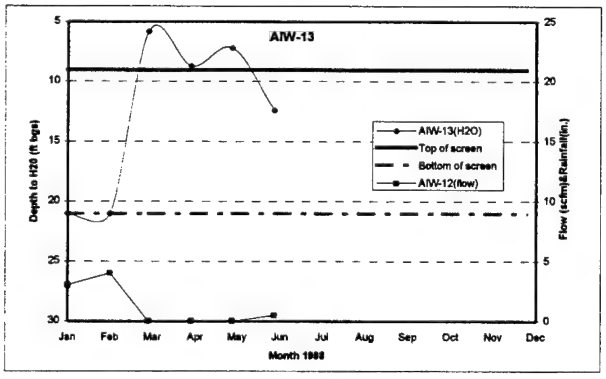
Gw_flow2.xls

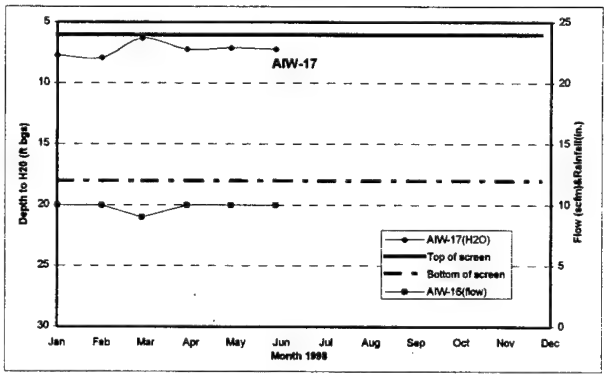


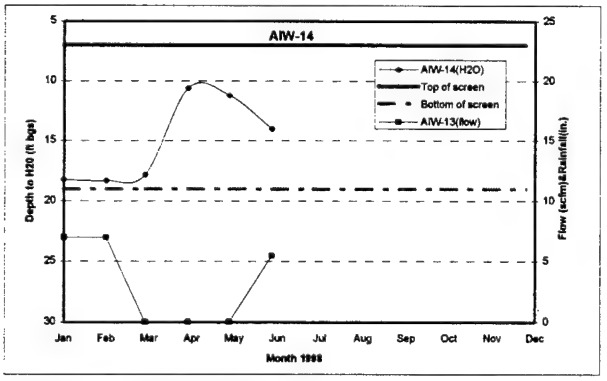


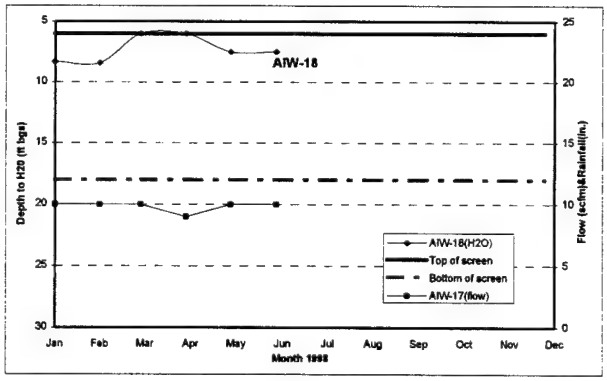












See Figure 11-1 for transect location.

Figure 18-2 Air Flow vs. Depth to Groundwater at NDA-8

Table 18-2 NDA-8 Groundwater Level Data

WELL NO	Well Depth below TOC (ft)	Top of Screen below TOC (ft)	Groundwater Depth Below TOC (ft)											
			Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Apr-98	May-98	Jun-98
AIW-1	26	14	**13**	16	16.7	18.6	18.5	18.5	18.8	19.2	19.2	17.5	16	17.4
AIW-2	26	14	14.3	15.6	17.7	26	26	26	26	26	26	18.4	16.5	18.1
AIW-3	25	13	14.8	18.9	21.8	22.6	22	22.1	23.2	24.4	24.4	15.8	14.5	17.3
AIW-4	25	13	**12.4**	17.3	19.4	20.1	18.7	18.6	20.4	20.5	17.5	13.8	12.5	15.5
AIW-5	24	12	14.2	16.5	19.3	20.2	19	19.5	20.1	20.5	20.3	14.3	14	15.7
AIW-6	24	12	13.4	17.4	19.9	20.7	19.7	19.9	20.3	21.1	20.6	14.4	14.1	16.4
AIW-7	23	11	16.2	20.2	23	23	23.3	23.6	23	23	23	17.6	17	19.2
AIW-8	22	10	12.8	15.7	16.2	16.9	15.3	16.1	17.3	17	15.3	13.5	12.9	14.4
AIW-9	23	11	**10.8**	15.6	18.3	19.1	17.4	17.9	19.1	19.9	19.1	9.9	**10.5**	14.1
AIW-10	22	10	13.3	15.6	16.4	16.9	15	18.9	16.8	16.7	14.8	14.2	13.5	14.7
AIW-11	21	9	11.9	14.1	14	10.4	10.3	11.2	13	12.3	10.1	10.3	12.7	14.6
AIW-12	20	8	9.8	13.2	12.5	13.6	11.8	12.9	14.3	14.6	10	9.5	**7.3**	10.8
AIW-13	21	9	10.5	13	10.3	10.6	10.2	13	21	21	**5.8**	**8.7**	**7.2**	12.4
AIW-14	19	7	10.1	14.8	17	17.8	17.5	17.5	18.2	18.3	17.8	10.6	11.2	14
AIW-15	19	7	9.4	9.6	9.3	9.7	8.3	9	10.6	10.4	10.4	12.6	12.5	15
AIW-16	19	7	14.1	15.1	15	15.2	14.9	15	19	15.4	14	15	15.1	15
AIW-17	18	6	6.9	7.3	7.2	7	7.1	7.3	7.7	7.9	6.3	7.2	7.1	7.2
AIW-18	18	6	7	8	7.5	8	7	7.8	8.3	8.4	6	6	7.5	7.5
AIW-19	23	11	12.4	12.6	12.4	12.6	12.4	12.5	12	13	11.8	12.7	12.5	12.5
AIW-20	23	11	12	13.6	**10.9**	**10.8**	**10.1**	12.9	13	12.5	**9.4**	**8.3**	**11**	12.4
AIW-21	21	9	10.6	14.1	13.9	14.8	13	14	21	16	21	7.3	9	11.9
AIW-22	22	10	**9.7**	14.2	14.3	15.25	13.4	14.4	22	17.4	12.3	7.3	8.5	9.5
AIW-23	24	12	**10.6**	16.9	20.6	21.3	18.3	19.6	24	24	13	8.2	9.8	10.8

Bolded value indicates water level is at or above the top of the screen.
TOC = top of casing.

19.0 POWER PLANT DRAINAGE PIPE

19.1 OPERATIONS

The PPDP, located in OU 9, consists of 18 AIWs and 24 MPs (Figure 19-1). BEI installed the PPDP biovent system in the fall of 1995. During July 1997 three new MPs—one (MP-10) with oxygen sensors and two (MP-9-3.5 and MP-9-8.5) without oxygen sensors—were installed in accordance with the recommendations made in the previous semiannual report. These areas did not contain sufficient soil gas data to evaluate biodegradation activity. Since BEI assumed responsibility for the bioventing O&M, the system has operated 804 days as of June 30, 1998. This system was down during portions of the summer of 1996 due to high water levels, but has since operated continuously with only minor interruptions for respiration testing and general maintenance.

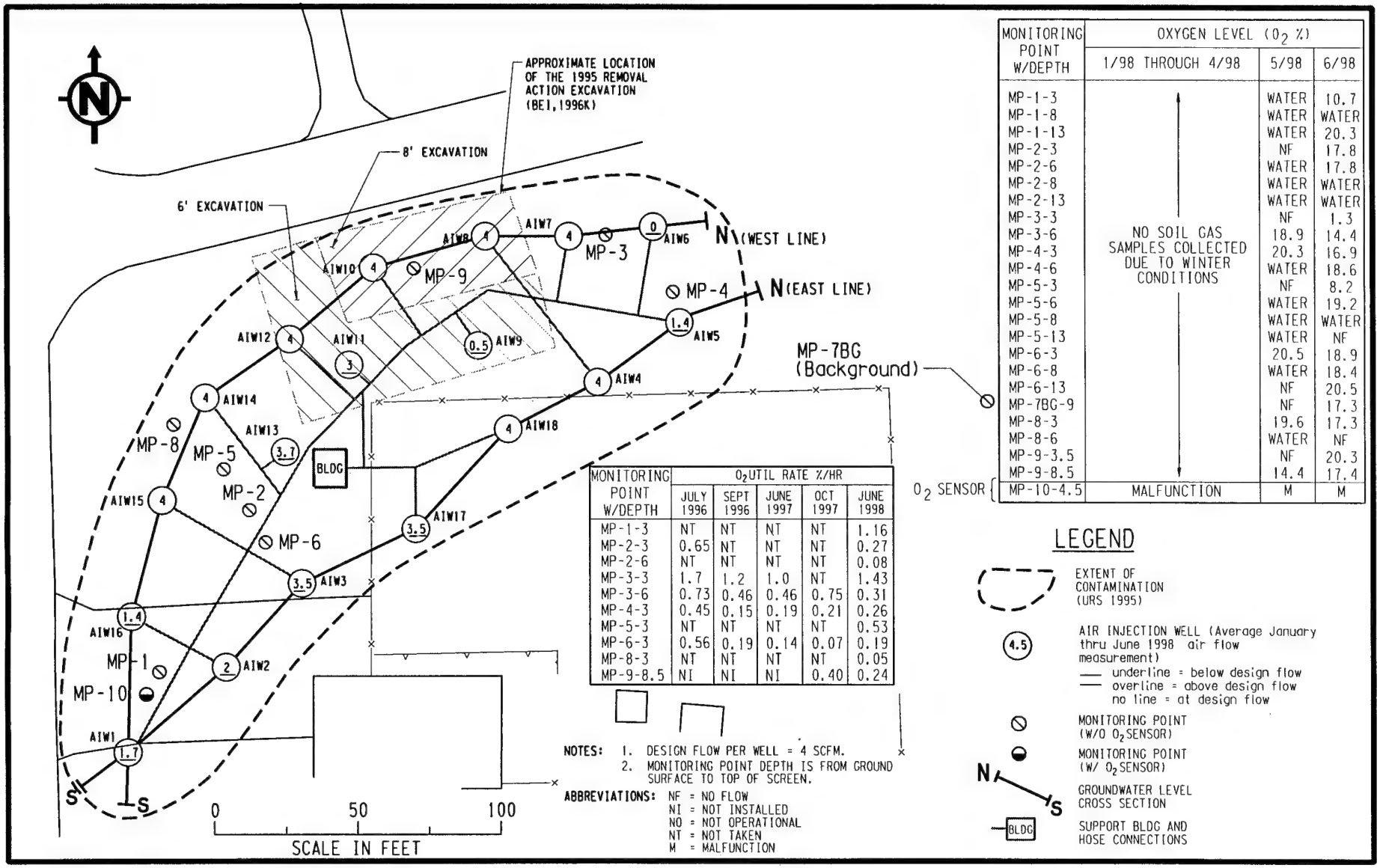
System flows were typically at the design flow rate of 4 scfm (Table 19-1) with a slight downturn on several AIWs during April through June. Groundwater levels shown in Table 19-2 confirm that several screens were fully inundated during March and April. April total air flow was the lowest monthly total for the 6-month reporting period. System injection pressures were not raised above 3.4 psi.

19.2 CONCLUSIONS AND RECOMMENDATIONS

In general, the contaminated area is being aerated at air flow rates equal to or slightly below the 4 scfm design rate. The most easterly AIW (AIW-6) has remained ineffective since May 1997 (zero flow). As mentioned above, air flow has not been impeded by partial inundations and even fully inundated conditions as illustrated on Figures 19-2 and 19-3 (air flow on Table 19-1). Low oxygen levels taken in May and June were recorded in MP-1-3, MP-3-3, MP-3-6, MP-5-3, and MP-9-8.5 (readings of 10.7, 1.3, 14.4, 8.2, and 14.4 percent oxygen, respectively). The remaining MPs either had oxygen readings greater than 17 percent or yielded no data because of saturation/no flow.

Respiration tests were run at the previous 6 locations with data and 4 new locations (Figures A-21 through A-25). Three of the 6 respiration tests performed at MPs with prior history showed a decrease in respiration, thus indicating degradation is occurring (MP-2-3, MP-3-6, and MP-9-8.5). Active biodegradation remains at MP-3-3. Elevated TVH readings were again noted in MP-9-8.5 (see Table 19-1). It appears that approximately 3 ft of unsaturated contaminated soils (located below the 1995 removal; see Figure 19-1) are the probable source of the volatiles. Contaminated saturated soils may exist below these unsaturated soils, thus continually providing volatiles. Even MP-9-3.5, located in the backfill, has elevated TVH readings noted during the respiration tests. Unfortunately, both AIW-8 and AIW-10 (each screened to about 11.8 ft bgs) are partially inundated most of time to a depth of 8 ft bgs. Confirmation sampling will be performed during the summer of 1998.

Overall Recommendation for PPDP: No changes are recommended since the AIWs are working as designed and contaminated soils still are believed to remain, based on low oxygen readings and elevated carbon dioxide and TVH readings. Oxygen utilization rates show a general decline, likely attributable to the ongoing biodegradation. Confirmation soil samples should be evaluated as soon as possible.



MONITORING POINT W/DEPTH	OXYGEN LEVEL (O_2 %) 1/98 THROUGH 4/98	5/98	6/98
MP-1-3	NO SOIL GAS SAMPLES COLLECTED DUE TO WINTER CONDITIONS	WATER	10.7
MP-1-8		WATER	WATER
MP-1-13		WATER	20.3
MP-2-3		NF	17.8
MP-2-6		WATER	17.8
MP-2-8		WATER	WATER
MP-2-13		WATER	WATER
MP-3-3		NF	1.3
MP-3-6		18.9	14.4
MP-4-3		20.3	16.9
MP-4-6		WATER	18.6
MP-5-3		NF	8.2
MP-5-6		WATER	19.2
MP-5-8		WATER	WATER
MP-5-13		WATER	NF
MP-6-3		20.5	18.9
MP-6-8		WATER	18.4
MP-6-13		NF	20.5
MP-7BG-9		NF	17.3
MP-8-3		19.6	17.3
MP-8-6		WATER	NF
MP-9-3.5		NF	20.3
MP-9-8.5		14.4	17.4
MP-10-4.5	MALFUNCTION	M	M

MONITORING POINT W/DEPTH	O_2 UTIL RATE %/HR JULY 1996	SEPT 1996	JUNE 1997	OCT 1997	JUNE 1998
MP-1-3	NT	NT	NT	NT	1.16
MP-2-3	0.65	NT	NT	NT	0.27
MP-2-6	NT	NT	NT	NT	0.08
MP-3-3	1.7	1.2	1.0	NT	1.43
MP-3-6	0.73	0.46	0.46	0.75	0.31
MP-4-3	0.45	0.15	0.19	0.21	0.26
MP-5-3	NT	NT	NT	NT	0.53
MP-6-3	0.56	0.19	0.14	0.07	0.19
MP-8-3	NT	NT	NT	NT	0.05
MP-9-8.5	NI	NI	NI	0.40	0.24

NOTES:
1. DESIGN FLOW PER WELL = 4 SCFM.
2. MONITORING POINT DEPTH IS FROM GROUND SURFACE TO TOP OF SCREEN.

ABBREVIATIONS:
NF = NO FLOW
NI = NOT INSTALLED
NO = NOT OPERATIONAL
NT = NOT TAKEN
M = MALFUNCTION

LEGEND

- EXTENT OF CONTAMINATION (URS 1995)
- (4.5) AIR INJECTION WELL (Average January thru June 1998 air flow measurement)
  - underline = below design flow
  - overline = above design flow
  - no line = at design flow
- MONITORING POINT (W/O O_2 SENSOR)
- MONITORING POINT (W/ O_2 SENSOR)
- N S GROUNDWATER LEVEL CROSS SECTION
- BLDG SUPPORT BLDG AND HOSE CONNECTIONS

22784/043/FIG3-23.DGN

Figure 19-1
PPDP Biovent System Layout and Average Wellhead Flow

Table 19-1 PPDP Air Flow and Monitoring Point Data

Air Injection Well	Screen Interval ft/bgs top	bottom	Overburden Pressure[1] (psi)	Design Air Flow (scfm)	Individual Well Head Flow (scfm) January 1998	February 1998	March 1998	April 1998	May 1998	June 1998	Average Jan - Jun
AIW-1	8.9	13.8	6.2	4	3.6	3.7	3	0	0	0	1.7
AIW-2	8.9	13.8	6.2	4	3.2	3.2	3	1.5	1	0	2.0
AIW-3	6.8	11.8	4.7	4	4	4	4	2.6	3.4	3.1	3.5
AIW-4	4.6	9.5	3.2	4	4	4	4	4	4	4	4.0
AIW-5	6.9	11.8	4.8	4	2.7	2.7	2.2	0	1	0	1.4
AIW-6	6.9	11.8	4.8	4	0	0	0	0	0	0	0.0
AIW-7	3.2	8.1	2.2	4	4	4	4	4	4	4	4.0
AIW-8	7.8	11.8	5.4	4	4	4	4	4	4	4	4.0
AIW-9	7.8	11.8	5.4	4	1	1	1.2	0	0	0	0.5
AIW-10	7.8	11.8	5.4	4	4	4	4	4	4	4	4.0
AIW-11	6.9	11.8	4.8	4	4	4	4	1.6	2.3	2	3.0
AIW-12	6.9	11.8	4.8	4	4	4	4	4	4	4	4.0
AIW-13	6.9	11.8	4.8	4	4	4	4	2.4	4	3.7	3.7
AIW-14	4.9	9.8	3.4	4	4	4	4	4	4	4	4.0
AIW-15	5.5	10.5	3.8	4	4	4	4	4	4	4	4.0
AIW-16	8.9	13.8	6.2	4	3	3.2	2.2	0	0	0	1.4
AIW-17	6.9	11.8	4.8	4	4	4	4	1.8	3	4	3.5
AIW-18	4.7	9.7	3.3	4	4	4	4	4	4	4	4.0
Total air flow:				72	61.5	61.8	59.6	41.9	46.7	44.8	
Pressure (psi):					3.4	3.4	3.4	2.5	2.4	2.2	

Monitoring Point	Screen Interval (ft bgs) top	bottom		Soil Gas Sampling Results January 1998 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	February 1998 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	March 1998 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	April 1998 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	May 1998 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	June 1998 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)
MP-1-3	3	3.5	O_2 Util. Rate = 1.16%/hr[4]	No Soil Gas			No Soil Gas			No Soil Gas			No Soil Gas				water		10.7	11.7	flame out
MP-1-8	8	8.5		Samples Collected			Samples Collected			Samples Collected			Samples Collected				water			water	
MP-1-13	13	13.5		due to Winter Conditions			due to Winter Conditions			due to Winter Conditions			due to Winter Conditions				water		20.3	0.6	257
MP-2-3	3	3.5	O_2 Util. Rate = 0.27%/hr[3]														no flow		17.8	1.1	731
MP-2-6	6	6.5	O_2 Util. Rate = 0.08%/hr[3]														water		17.8	1.3	41
MP-2-8	8	8.5															water			water	
MP-2-13	13	13.5															water			water	
MP-3-3	3	3.5	O_2 Util. Rate = 1.43%/hr[4]														no flow		1.3	9.6	50
MP-3-6	6	6.5	O_2 Util. Rate = 0.31%/hr[4]													18.9	0.5	240	14.4	1.2	300
MP-4-3	3	3.5	O_2 Util. Rate = 0.26%/hr[4]													20.3	0.1	8.3	16.9	0.5	7.3
MP-4-6	6	6.5															water		18.6	0.4	8.9
MP-5-3	3	3.5	O_2 Util. Rate = 0.53%/hr[4]														no flow		8.2	7.4	flame out
MP-5-6	6	6.5															water		19.2	1.0	936
MP-5-8	8	8.5															water			water	
MP-5-13	13	13.5															water			no flow	
MP-6-3	3	3.5	O_2 Util. Rate = 0.19%/hr[3]													20.5	0.0	4.3	18.9	0.1	13
MP-6-8	8	8.5															water		18.4	0.4	246
MP-6-13	13	13.5															no flow		20.5	0.0	64
MP-7BG-9	9	14.5	Background location														no flow		17.3	3.4	88
MP-8-3	3	3.5	O_2 Util. Rate = 0.05%/hr[3]													19.6	1.4	3	17.3	1.8	1
MP-8-6	6	6.5															water			no flow	
MP-9-3.5	3.5	4															no flow		20.3	0.1	200.0
MP-9-8.5	8.5	9	O_2 Util. Rate = 0.24%/hr[4]													14.4	2.8	64.1	17.4	1.4	1723
MP-10-4.5	4.5	5	O_2 Sensor	malf	na	na	malf	na	na	malf	na	na	malf	na	na	malf	na	na	malf	na	na

[1] Maximum pressure before potential for fracturing of soil. Calculated at top of screen assuming density of soil is 100 lbs/ft^3.
[2] The monthly O_2 sensor results is the average for month. See biovent monthly reports for daily values.
[3] Test performed on 6/29/98.
[4] Test performed on 6/24/98.
bgs = below ground surface, malf = malfunctioned.

NOTE: AIW's that are noted to be "off" have been shutdown due to well seal leaks.

NOTE: Flame out occurs due to low oxygen levels.

Table 19-2 PPDP Groundwater Level Data

Power Plant Discharge Pipe Groundwater Levels from January through June 1998

Well No.	Well Depth below TOC	Top of Screen below TOC	Jan-98	Feb-98	Mar-98	Apr-98	May-98	Jun-98
AIW-1	15.9	10.8	15	15	10	14.7	9.8	9.3
AIW-2	15.9	10.8	15	15	10	15	12	11.9
AIW-3	13.9	8.7	13	13	8	9.5	11.4	11.3
AIW-4	11.3	6.4	9	9.3	7.2	6.3	8	7.7
AIW-5	13.9	8.8	13	13	8	13.1	12.6	12.4
AIW-6	13.9	8.8	13	13	8	13	13	13
AIW-7	10.3	5.0	9.5	9.5	8.5	8.5	8.6	8.6
AIW-8	13.7	9.5	11	10.9	11	10.9	10.9	11
AIW-9	13.8	9.6	13	13	9	13	13	13.7
AIW-10	13.9	9.7	12.3	12.5	11.1	11	11.2	11.1
AIW-11	13.9	8.8	13	13	8	13	13	13
AIW-12	13.8	8.7	13	13	10.2	9.5	9.6	9.2
AIW-13	13.7	8.6	13	13	9	8.5	9.9	9.3
AIW-14	11.8	8.7	9.8	11	7.8	7.3	8.4	8.3
AIW-15	12.7	7.5	10.4	11.7	7.7	6.7	7.5	7.6
AIW-16	16.0	10.9	15	15	10	15	9	8.3
AIW-17	13.7	8.6	12.9	11.7	10.6	8	10.5	10.1
AIW-18	11.7	6.4	8.7	9.1	7	6.2	7.4	7.3

Bolded value: indicates water level is at or above the top of the screen.

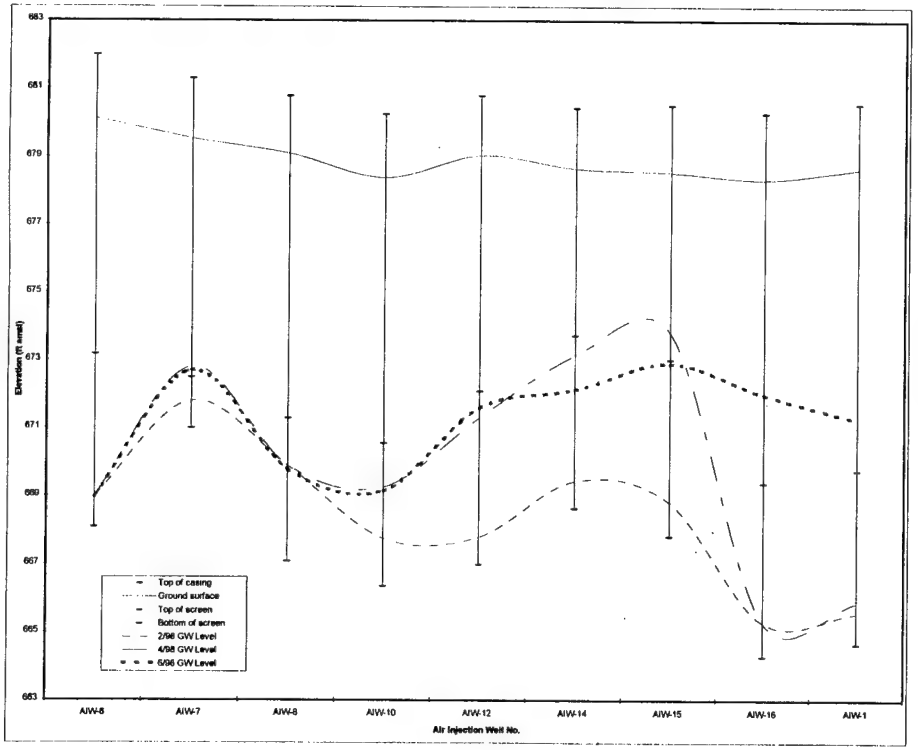
Groundwater Levels along North / South (Westline) Transect at PPDP

Well No.	Elevation at top of casing (ft amsl)	Elevation of ground (ft msl)	Elevation of water - FEB. (ft amsl)	Elevation of water - APR. (ft amsl)	Elevation of water - JUN. (ft amsl)	Depth to top of screen (ft)	Elevation to TOS (ft amsl)	Depth to bottom of screen (ft)	Elevation to BOS (ft amsl)
AIW-6	681.98	680.11	668.98	668.98	668.98	8.8	673.18	13.9	668.081
AIW-7	681.29	679.53	671.79	672.79	672.88	8.8	672.49	10.3	670.992
AIW-8	680.78	679.09	669.88	669.88	669.78	9.5	671.28	13.7	667.08
AIW-10	680.25	678.37	667.75	669.25	669.15	9.7	670.55	13.9	666.35
AIW-12	680.79	679.03	667.79	671.29	671.59	8.7	672.09	13.8	666.99
AIW-14	680.43	678.64	669.43	673.13	672.13	6.7	673.73	11.8	668.63
AIW-15	680.51	678.53	668.81	673.81	672.91	7.5	673.01	12.7	667.81
AIW-16	680.28	678.33	665.28	665.28	671.98	10.9	669.38	16	664.28
AIW-1	680.55	678.63	665.55	665.85	671.25	10.8	669.75	15.9	664.65

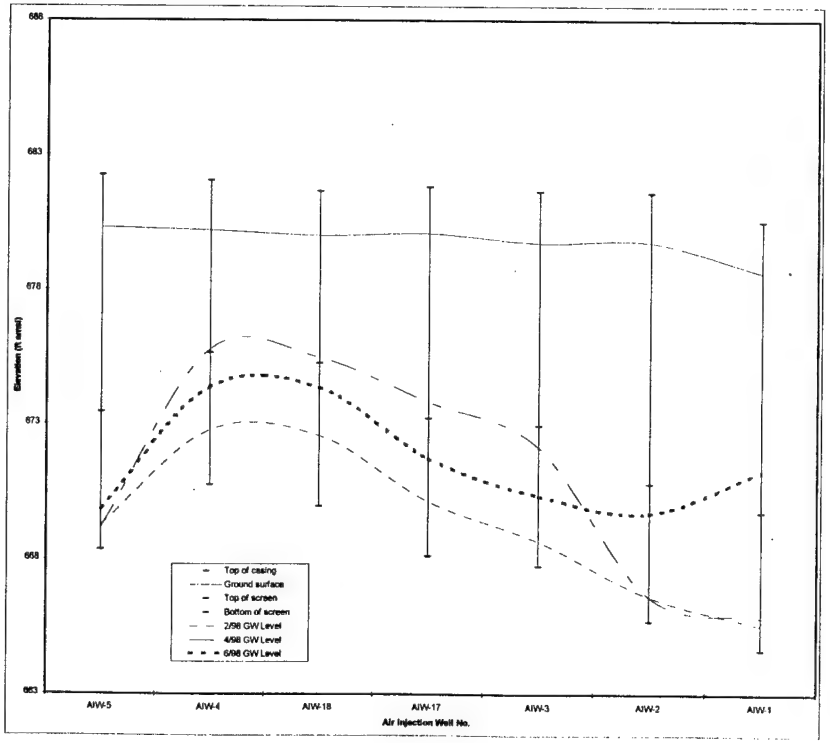
Groundwater Levels along North / South (Eastline) Transect at PPDP

Well No.	Elevation at top of casing (ft amsl)	Elevation of ground (ft amsl)	Elevation of water - FEB. (ft amsl)	Elevation of water - APR. (ft amsl)	Elevation of water - JUN. (ft amsl)	Depth to top of screen (ft)	Elevation to TOS (ft amsl)	Depth to bottom of screen (ft)	Elevation to BOS (ft amsl)
AIW-5	682.25	680.31	669.25	669.15	669.85	8.8	673.45	13.9	668.35
AIW-4	682.05	680.2	672.75	675.75	674.35	6.4	675.65	11.3	670.75
AIW-18	681.67	680.01	672.57	675.47	674.37	6.4	675.27	11.7	669.97
AIW-17	681.83	680.09	670.13	673.83	671.73	8.8	673.23	13.7	668.13
AIW-3	681.65	679.72	668.65	672.15	670.35	8.7	672.95	13.9	667.75
AIW-2	681.81	679.75	666.61	666.61	669.71	10.8	670.81	15.9	665.71
AIW-1	680.55	678.63	665.55	665.85	671.25	10.8	669.75	15.9	664.65

North / South Cross Section at PPDP - Westline (see Figure 19-1 for transect location)



North / South Cross Section at PPDP - Eastline (see Figure 19-1 for transect location)



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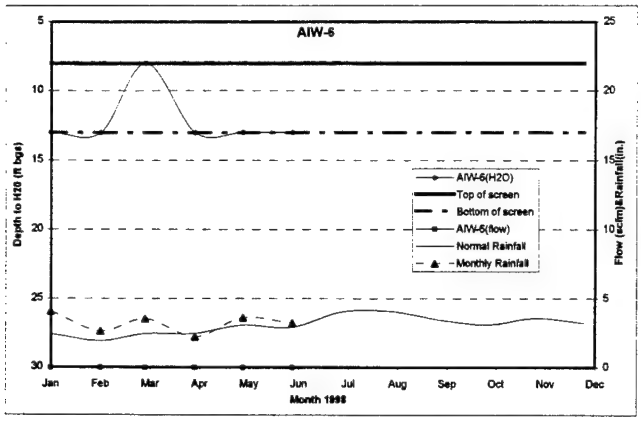
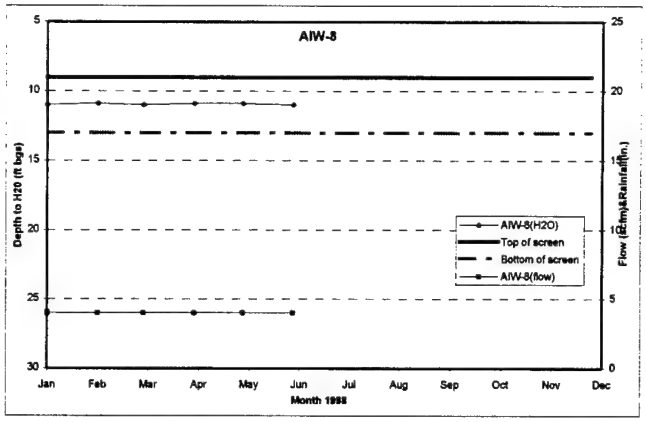
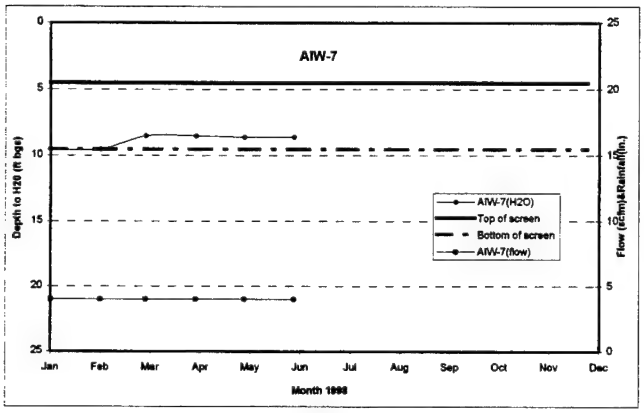
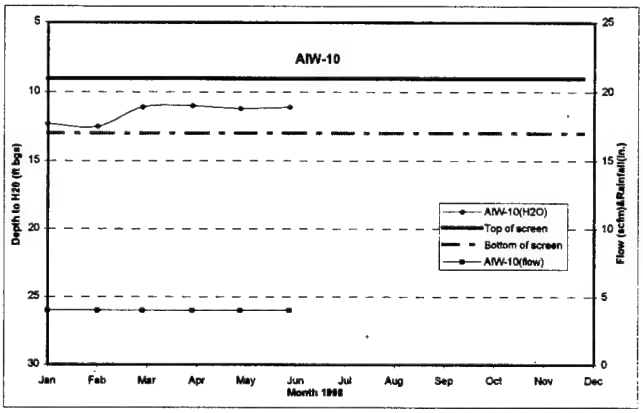
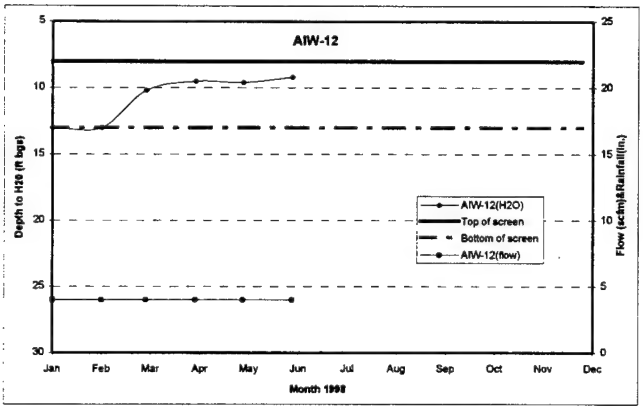
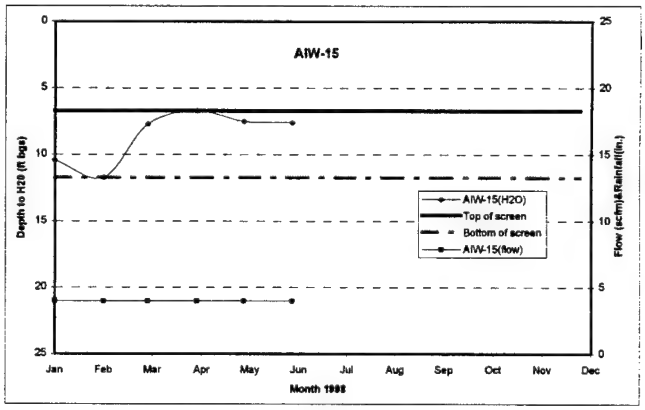


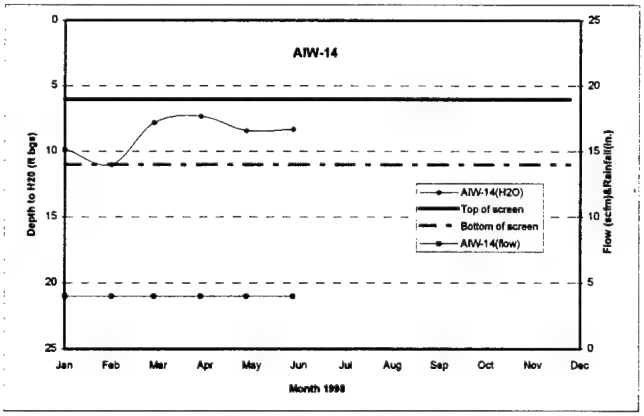


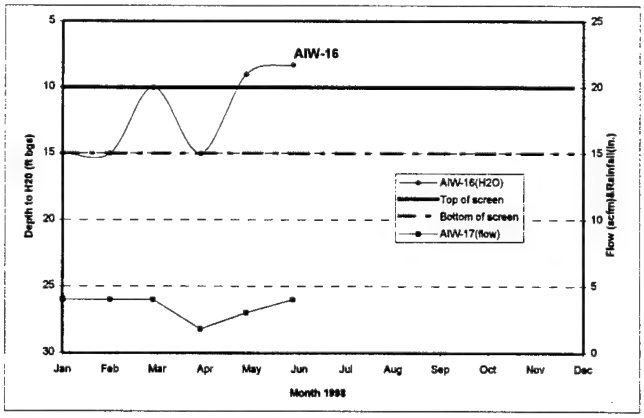






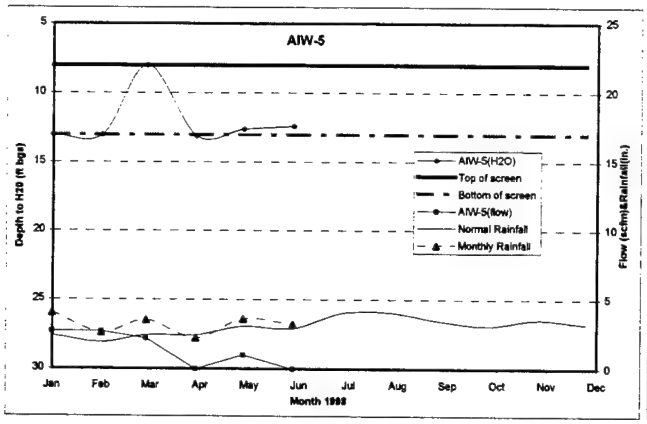


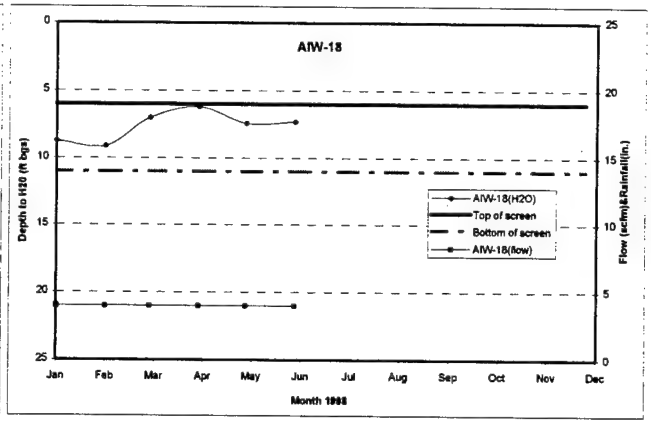


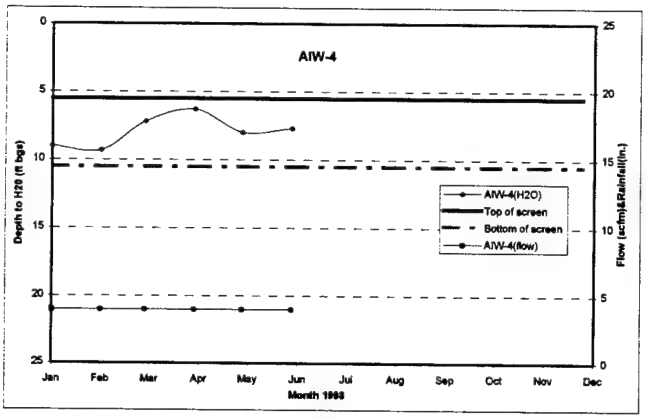


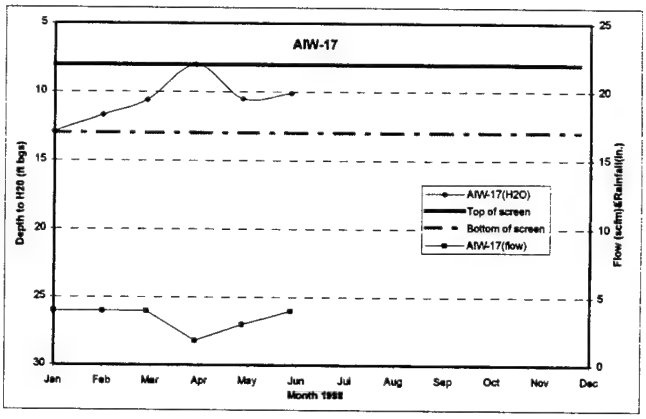
See Figure 19-1 for transect location.

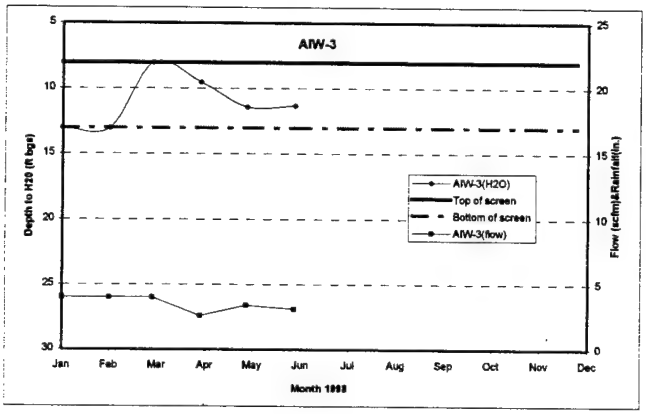
Figure 19-2 PPDP Groundwater/Air Flow Relations - Westline

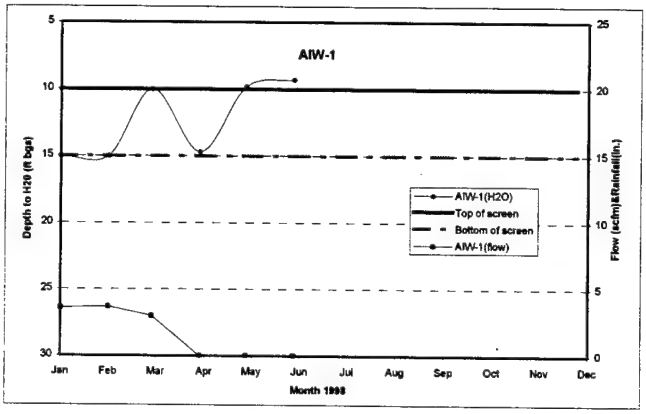


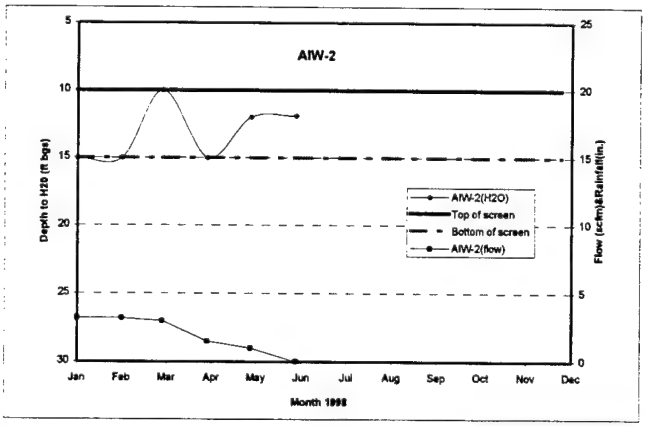












NOTE: See Figure 19-1 for transect location.

Figure 19-3 PPDP Groundwater/Air Flow Relations - Eastline

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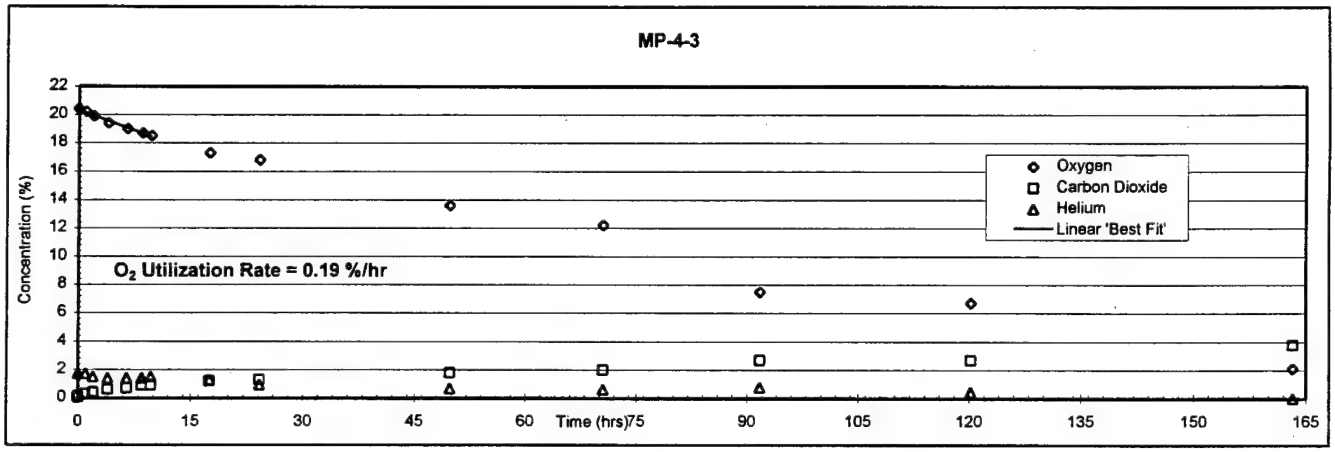
APPENDIX A

Time[1] (hrs)	MP-4-3					MP-4-13				
	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)
Pretest[2]	16.5	2.2	261	2	-	18.5	1.3	6	2	-
0.0	20.4	0.1	6	20	1.7	20.6	0	2	4	1.8
1.0	20.2	0.3	7	5	1.7	20.5	0	3	1	2.3
2.0	19.9	0.4	5	3	1.5	20.5	0	2	1	2.2
4.0	19.4	0.6	15	13	1.4	20.2	0.1	6	2	1.9
6.5	19	0.7	16	80	1.4	20	0.3	4	2	1.9
8.5	18.7	0.9	9	82	1.4	19.9	0.3	3	3	2
9.7	18.5	0.9	6	68	1.5	19.8	0.3	2	4	1.8
17.5	17.3	1.2	14	21	1.3	19.5	0.4	1	4	1.6
24.2	16.8	1.3	14	5	0.95	19.7	0.5	1	0	1.2
49.8	13.6	1.8	25	6	0.68	19	0.6	7	3	0.81
70.5	12.2	2	102	35	0.6	17.8	0.9	16	1	0.74
91.8	7.5	2.7	fo	12	0.76	17.4	1.1	13	3	0.59
120.2	6.7	2.7	fo	40	0.42	16.4	1.2	7	2	0.47
163.3	2.1	3.8	fo	21	nt	15.2	1.4	0	0	nt
	End of Test					End of Test				

[1] Test began on 6/23/98 at 1300 hrs. fo = flame out

[2] Pretest sample is collected before air/helium injection and after system was shutdown on 6/22/98 at 1715 hrs.

Note: Typical background oxygen utilization rates = 0.06 - 0.10 %/hr.



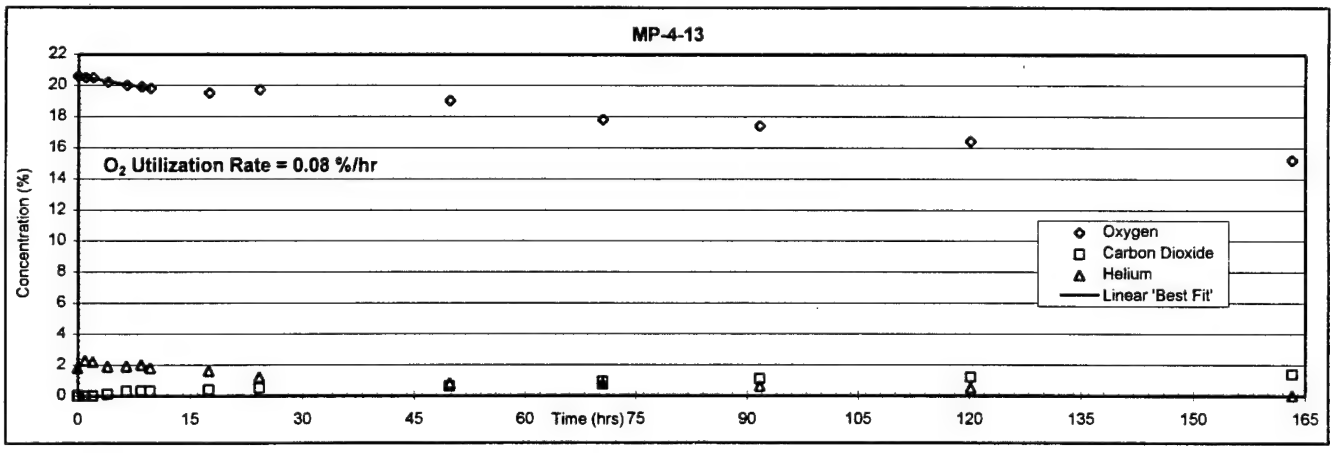


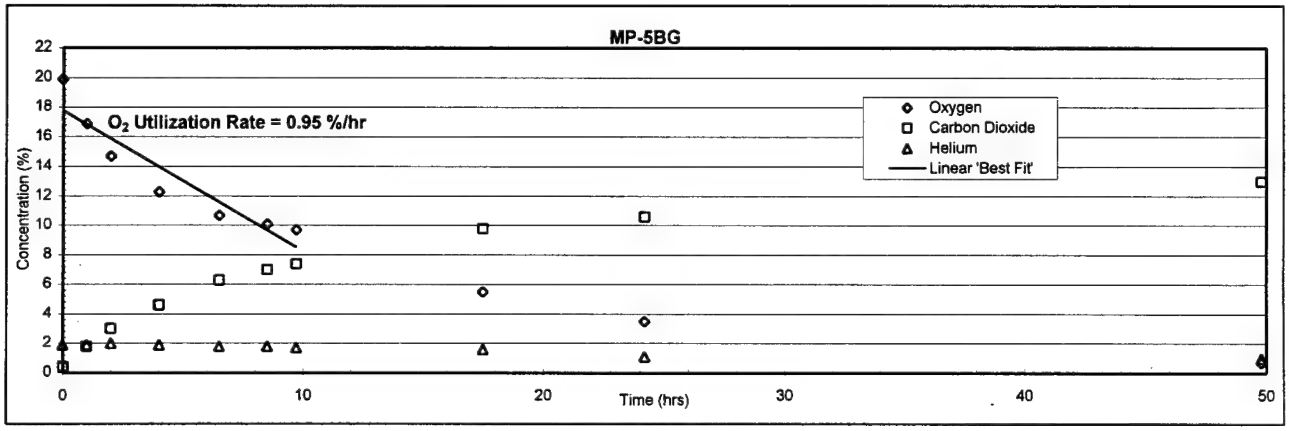
Figure A-1 Spring 1998 Respiration Test Results for MP-4-3 and MP-4-13 at the AHS

Time[1] (hrs)	MP-5BG					MP-9-6.5				
	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)
Pretest[2]	1.4	20	fo	5	-	18.5	0.8	1	1	-
0.0	19.9	0.4	319	17	1.9	20.6	0	5	22	1.9
1.0	16.9	1.8	637	3	1.9	20.5	0.1	2	1	2.1
2.0	14.7	3	612	3	2	20.5	0.2	3	1	2
4.0	12.3	4.6	557	7	1.9	20.2	0.3	26	8	1.9
6.5	10.7	6.3	fo	10	1.8	20	0.4	1	2	1.8
8.5	10.1	7	fo	14	1.8	19.9	0.5	1	3	2.1
9.7	9.7	7.4	fo	12	1.7	19.8	0.5	1	3	1.8
17.5	5.5	9.8	fo	4	1.6	19.5	0.6	4	0	1.9
24.2	3.5	10.6	fo	5	1.1	19.7	0.6	1	1	1.3
49.8	0.7	13	fo	7	1	19	0.8	20	10	0.96
70.5	End of test					13.8	1.1	5	1	0.91
91.8						12.1	1.3	4	3	0.93
120.2						10.2	1.4	0	1	0.75
163.3						7.2	1.8	fo	0	nt
						End of test				

[1] Test began on 06/23/98 at 1300 hrs. fo = flame out

[2] Pretest sample is collected before air/helium injection and after system is shutdown for a minimum of 24 hrs.

Note: Typical background oxygen utilization rates = 0.06 - 0.10 %/hr.



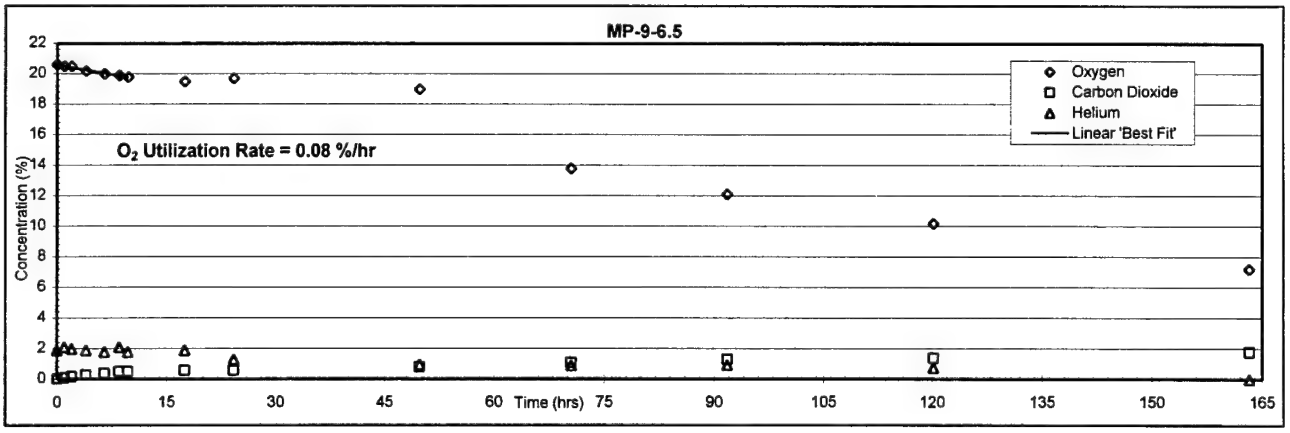
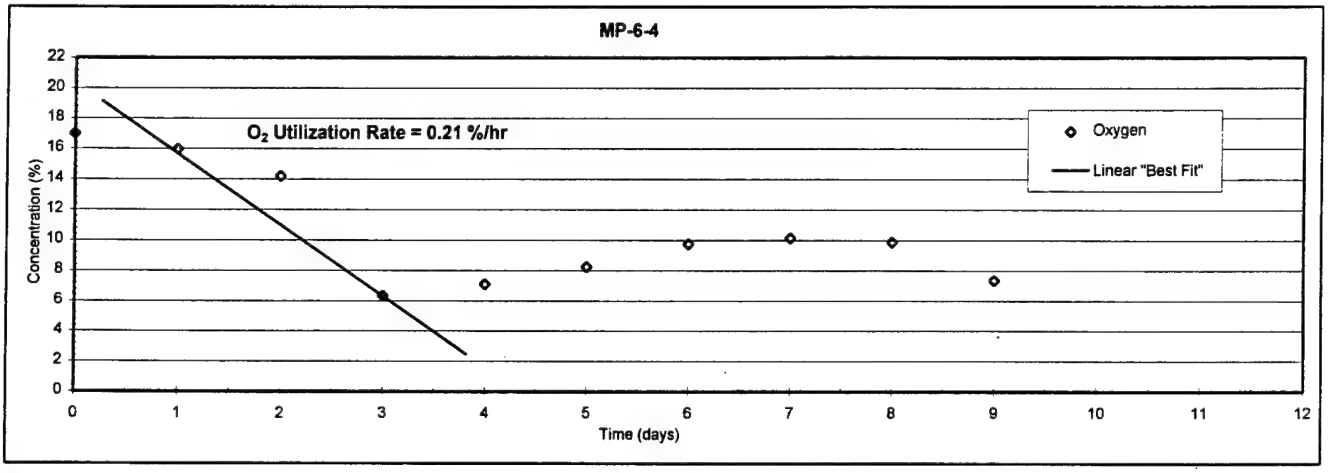
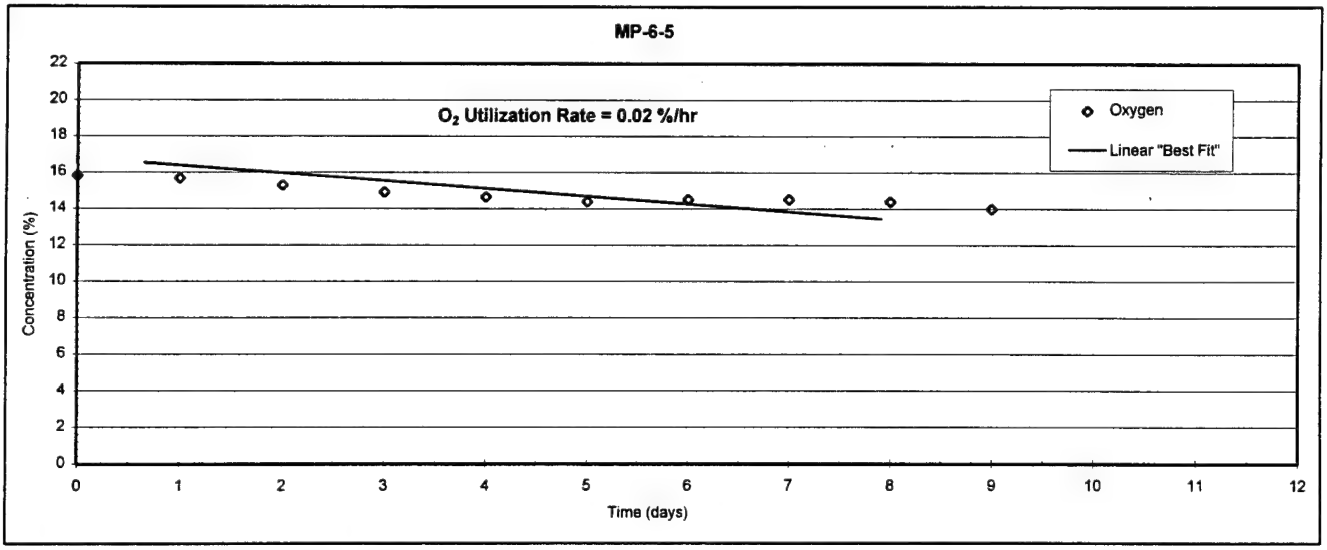


Figure A-2 Spring 1998 Respiration Test Results for MP-5BG and MP-9-6.5 at the AHS

	Time (days)	MP-6-4 O_2 %	MP-6-5 O_2 %
System off 2-10-98 1000 hrs	0	16.97	15.805
	1	15.96	15.675
	2	14.19	15.283
System on 2-13-98 1415 hrs	3	6.3333	14.891
	4	7.0933	14.63
	5	8.2333	14.368
	6	9.75	14.499
	7	10.133	14.499
	8	9.88	14.368
	9	7.3466	13.976

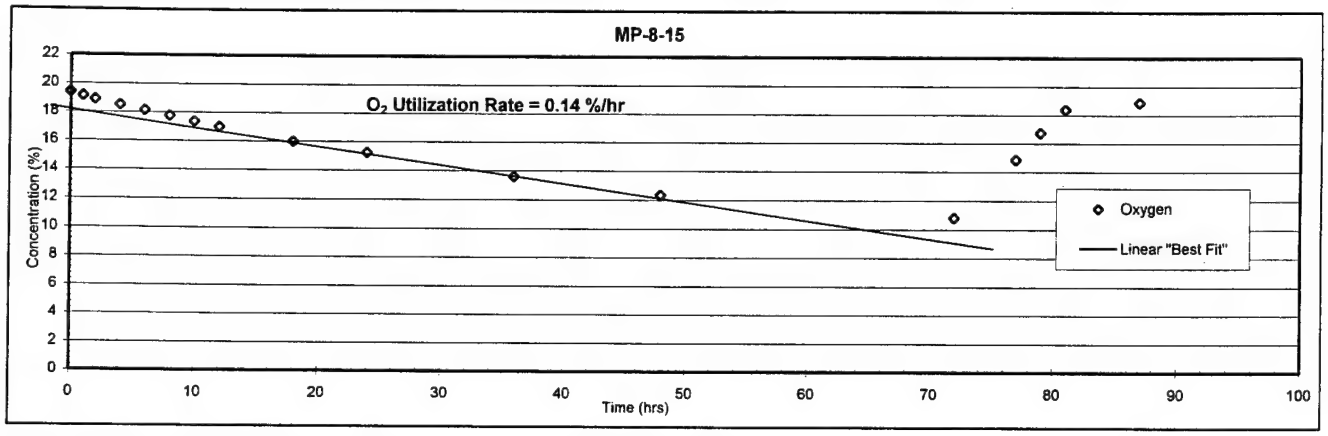




Note: Both MPs contain oxygen sensors. The test was performed by simply turning off the blower and automatically recording the oxygen levels every hour.

Figure A-3 Winter 1998 Respiration Test Results for MP-6-4 and MP-6-5 at the AHS

	Time	MP-8-15
	(hrs)	O_2 %
System off 2-10-98 1000 hrs	0	19.389
	1	19.137
	2	18.885
	4	18.507
	6	18.13
	8	17.752
	10	17.374
	12	16.996
	18	15.989
	24	15.234
	36	13.597
	48	12.338
System on 2-13-98 1415 hrs	72	10.827
	77	14.856
	79	16.745
	81	18.381
	87	18.885



Note: Both MPs contain oxygen sensors. The test was performed by simply turning off the blower and automatically recording the oxygen levels every hour.

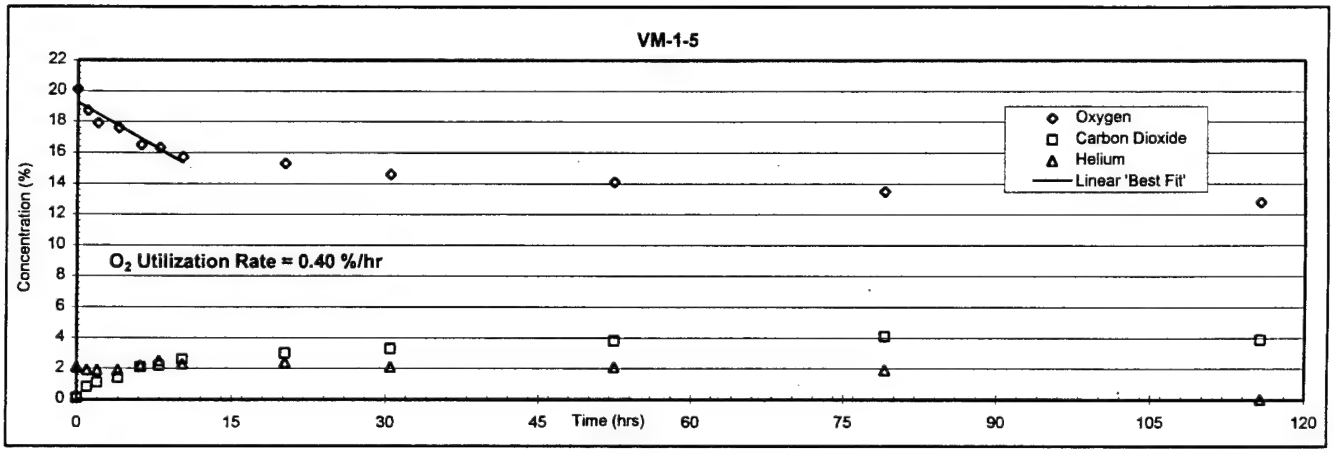
Figure A-4 Winter 1998 Respiration Test Results for MP-8-15 at the AHS

Time[1] (hrs)	VM-1-5					VM-1-8				
	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)
Pretest[2]	4.7	10.7	fo	6	-	5.3	2.1	fo	129	-
0.0	20.1	0.1	60	10	2.1	20.4	0	37	16	2.1
1.0	18.7	0.8	774	109	1.9	20.7	0	60	14	0.36
2.0	17.9	1.1	650	102	1.9	Abandoned test				
4.0	17.6	1.4	404	74	1.9	due to high O_2 and very				
6.2	16.5	2.1	340	53	2.2	low flow (<< 3 L/min)				
8.0	16.3	2.2	415	62	2.5					
10.3	15.7	2.6	227	67	2.3					
20.2	15.3	3	92	33	2.4					
30.5	14.6	3.3	46	16	2.1					
52.5	14.1	3.8	9	20	2.1					
79.1	13.5	4.1	4	75	1.9					
115.7	12.8	3.9	8	18	nt					
			End of Test							

[1] Test began on 6/25/98 at 1145 hrs. fo = flame out

[2] Pretest sample is collected before air/helium injection and after system was shutdown on 6/24/98 at 1800 hrs.

Note: Typical background oxygen utilization rates = 0.06 - 0.10 %/hr.



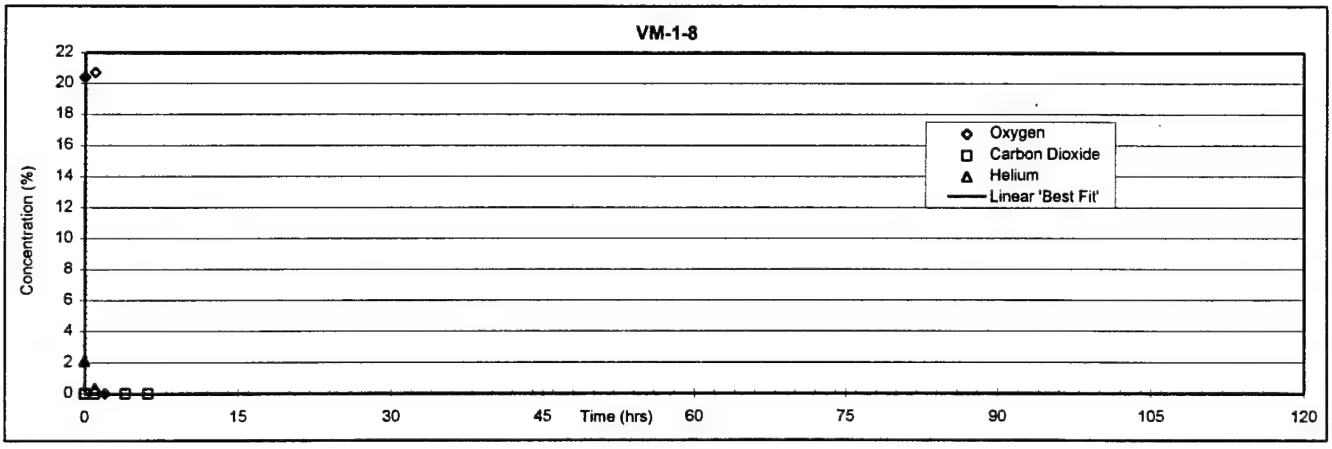


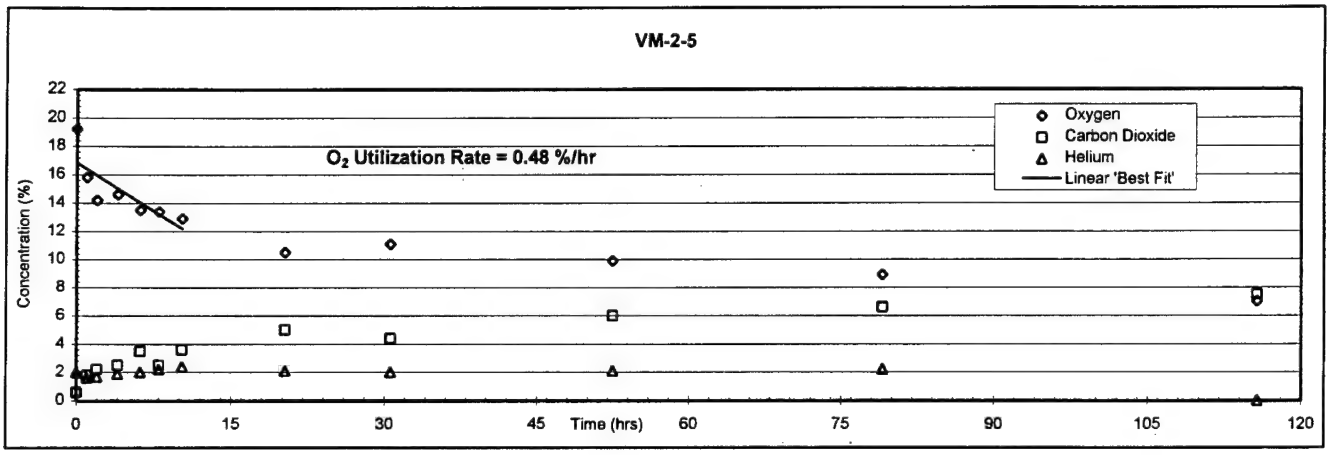
Figure A-5 Spring 1998 Respiration Test Results for VM-1-5 at the BXSS

Time[1] (hrs)	VM-2-5					MP-1-3.5				
	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)
Pretest[2]	0.9	14	fo	229	-	13.3	6.2	43	11	-
0.0	19.2	0.6	1882	302	2	20.3	0.3	13	7	1.6
1.0	15.8	1.8	4260	473	1.6	19.4	0.6	21	9	1.3
2.0	14.2	2.2	4312	543	1.7	19.4	0.9	32	8	1.1
4.0	14.6	2.5	3270	473	1.9	18.3	1.4	16	5	1.1
6.2	13.5	3.5	3800	510	2	17.9	1.9	39	11	1.3
8.0	13.4	2.5	3100	364	2.2	17.6	2.1	10	29	1.2
10.3	12.9	3.6	1960	323	2.4	16.9	2.4	20	69	0.99
20.3	10.5	5	fo	185	2.1	15.4	2.8	9	42	0.68
30.6	11.1	4.4	fo	248	2	12.1	3.9	33	34	0.85
52.5	9.9	6	fo	125	2.1	16.5	1.9	23	44	0.11
79.1	8.9	6.6	fo	370	2.2	End of Test				
115.7	7	7.5	fo	25	nt					
End of Test										

[1] Test began on 6/25/98 at 1145 hrs. fo = flame out

[2] Pretest sample is collected before air/helium injection and after system was shutdown on 6/24/98 at 1800 hrs.

Note: Typical background oxygen utilization rates = 0.06 - 0.10 %/hr.



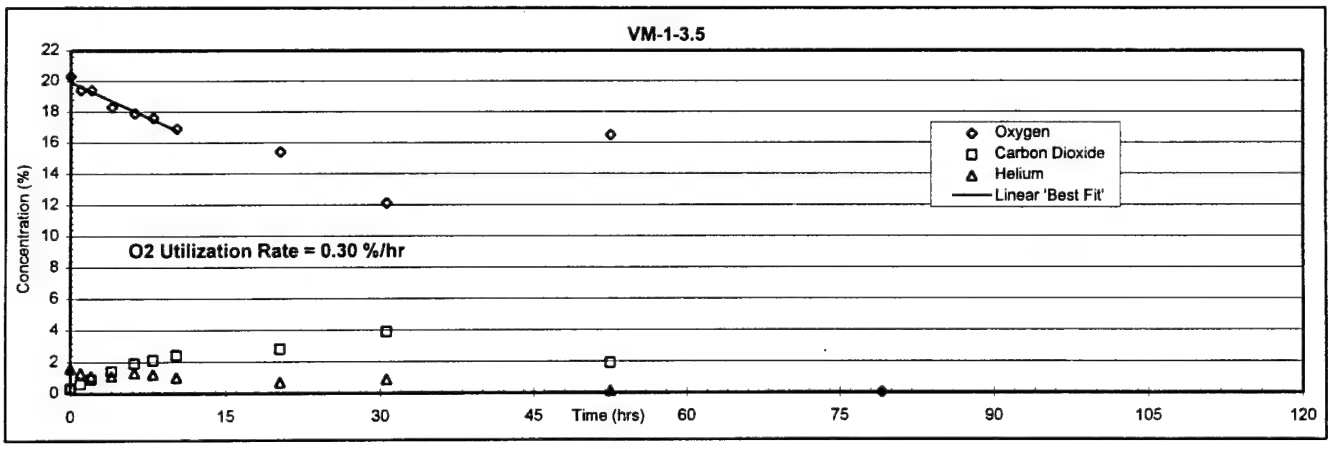


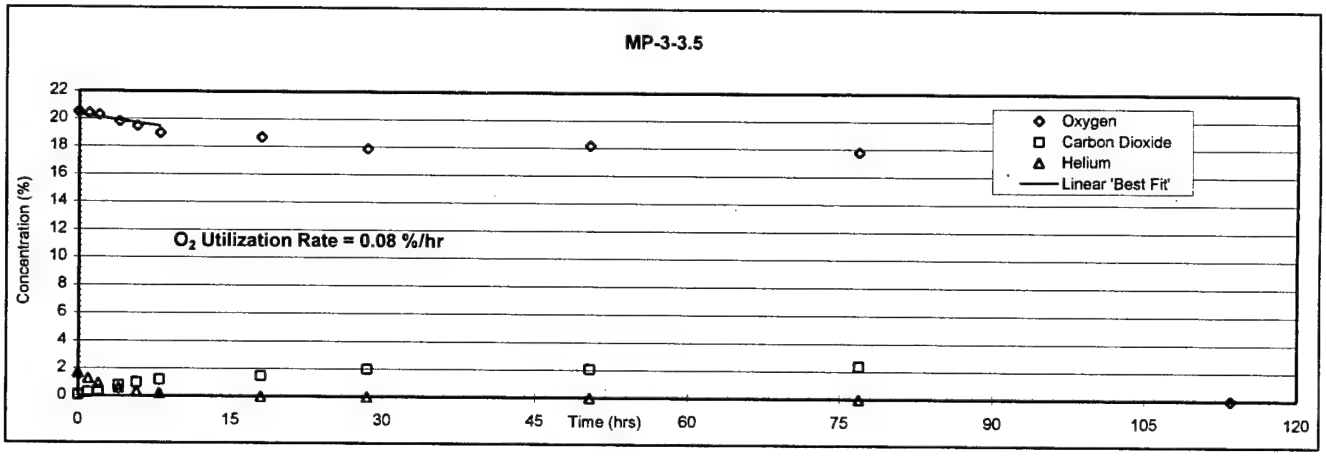
Figure A-6 Spring 1998 Respiration Test Results for VM-2-5 and MP-1-3.5 at the BXSS

Time[1] (hrs)	MP-3-3.5					MP-4BG				
	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)
Pretest[2]	17.3	3.3	1	11	-	16.8	2.8	2	2	-
0.0	20.5	0.1	6	2	1.7	20.1	0.4	12	4	2.2
1.0	20.4	0.3	5	2	1.3	20	0.4	14	3	2.5
2.0	20.3	0.4	9	3	0.95	20	0.5	10	3	2.2
4.0	19.8	0.8	6	1	0.61	19.5	0.8	10	2	3
5.8	19.5	1	7	2	0.37	19.4	1	14	5	2.3
8.0	19	1.2	5	14	0.23	19	1.2	9	33	2.9
18.0	18.7	1.5	2	15	0.01	18.9	1.4	6	24	2.2
28.5	17.9	2	6	14	0	18.4	1.5	9	6	2.4
50.4	18.2	2.1	4	13	0	18	1.8	7	34	2.2
76.9	17.8	2.4	1	3	0	17.3	2.3	10	35	1.9
113.5	End of Test					16.2	2.6	11	15	nt
						End of Test				

[1] Test began on 6/25/98 at 1400 hrs. fo = flame out

[2] Pretest sample is collected before air/helium injection and after system was shutdown on 6/24/98 at 1800 hrs.

Note: Typical background oxygen utilization rates = 0.06 - 0.10 %/hr.



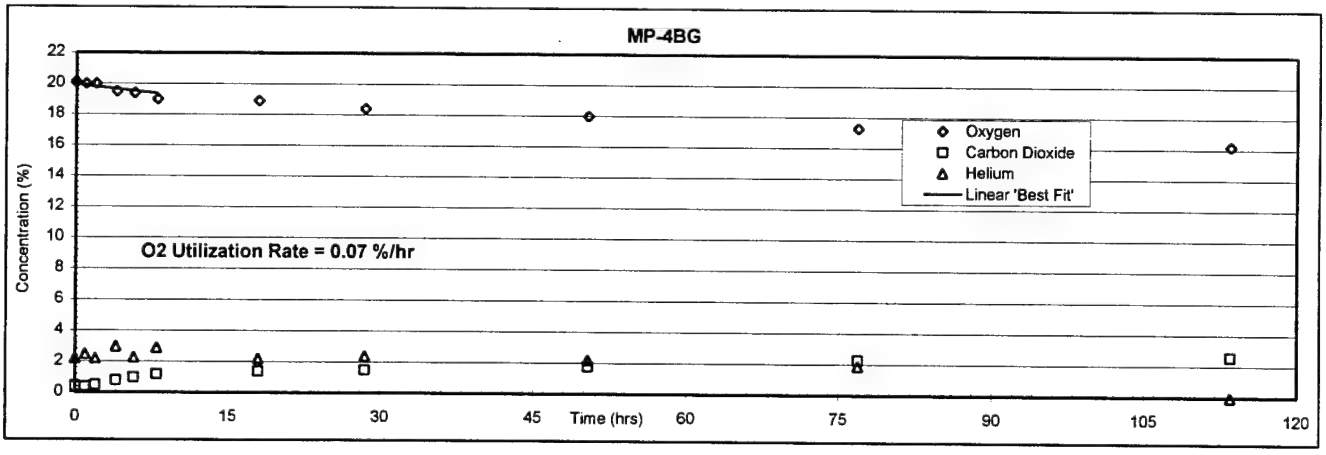


Figure A-7 Spring 1998 Respiration Test Results for MP-3-3.5 and MP-4BG at the BXSS

Time[1] (hrs)	MP-2-8.5				
	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)
Pretest[2]	18.2	0.9	10	9	-
0.0	20.2	0.1	14	5	2
1.0	20	0.3	9	3	1.6
2.0	19.9	0.3	10	2	1.7
4.0	19.1	0.5	14	2	1.9
5.8	19.1	0.5	12	3	2
8.0	18.6	0.6	12	21	2.2
18.0	17.9	0.7	7	20	2.4
28.5	16.5	0.8	10	14	2.1
50.4	14.9	0.9	8	50	2
76.8	12.5	1.1	4	10	2.1
113.5	9.2	1.2	fo	8	2.2
			End of Test		

[1] Test began on 6/25/98 at 1400 hrs. fo = flame out

[2] Pretest sample is collected before air/helium injection and after system was shutdown on 6/24/98 at 1800 hrs.

Note: Typical background oxygen utilization rates = 0.06 - 0.10 %/hr.

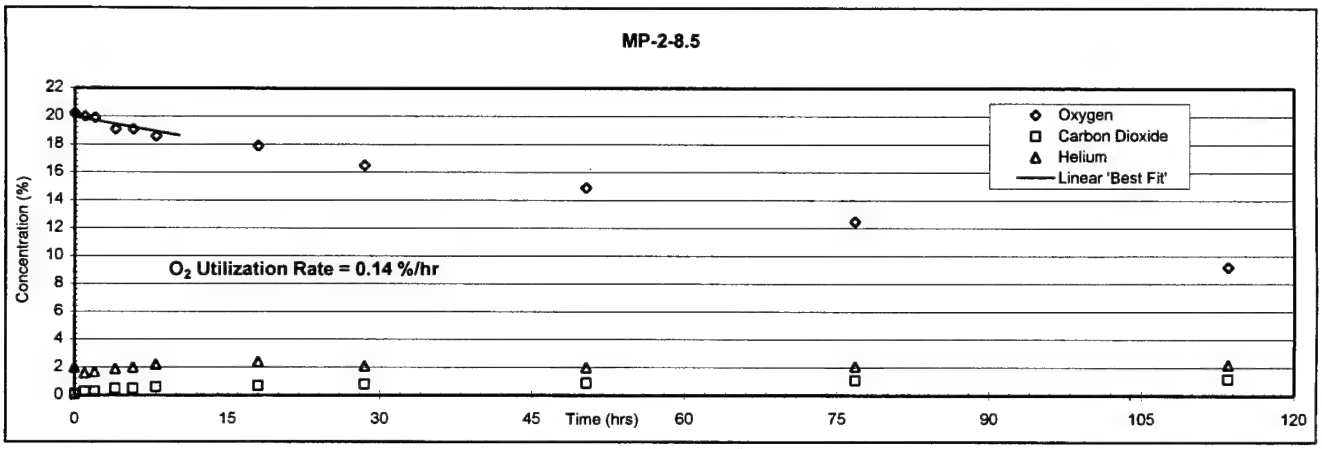


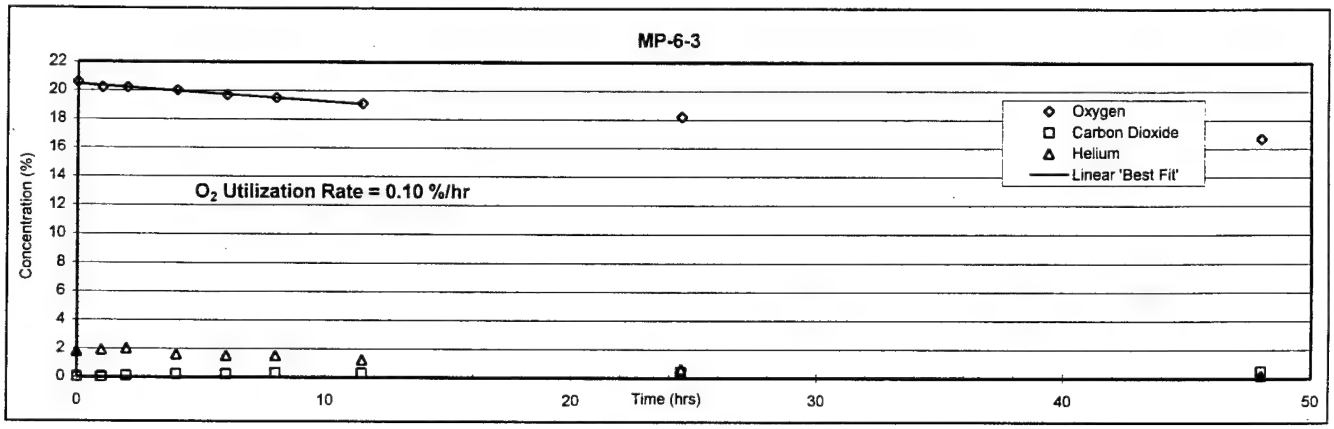
Figure A-8 Spring 1998 Respiration Test Results for MP-2-8.5 at the BXSS

Time[1] (hrs)	MP-6-3					MP-7-3				
	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)
Pretest[2]	17.8	3.6	7	17	-	3.1	10.7	fo	30	-
0.0	20.6	0	12	9	1.8	20.6	0	24	9	1.7
1.0	20.2	0	6	8	1.9	19.5	0.5	33	11	1.8
2.0	20.2	0.1	8	17	2	19	0.7	23	9	1.9
4.0	20	0.2	13	132	1.6	17.6	1.3	54	18	1.3
6.0	19.7	0.2	10	7	1.5	16.5	1.5	26	7	1.4
8.0	19.5	0.3	15	15	1.5	13.8	3	60	52	1.5
11.5	19.1	0.3	7	200	1.2	10.3	4.4	45	40	1.1
24.5	18.2	0.4	3	nt	0.6	6.9	5.7	fo	nt	0.4
48.0	16.7	0.5	4	160	0.2	1.3	9.7	fo	nt	0.2
	End of Test					End of Test				

[1] Test began on 7/1/98 at 0945 hrs. fo = flame out

[2] Pretest sample is collected before air/helium injection and after system was shutdown on 6/30/98 at 0900 hrs.

Note: Typical background oxygen utilization rates = 0.06 - 0.10 %/hr.



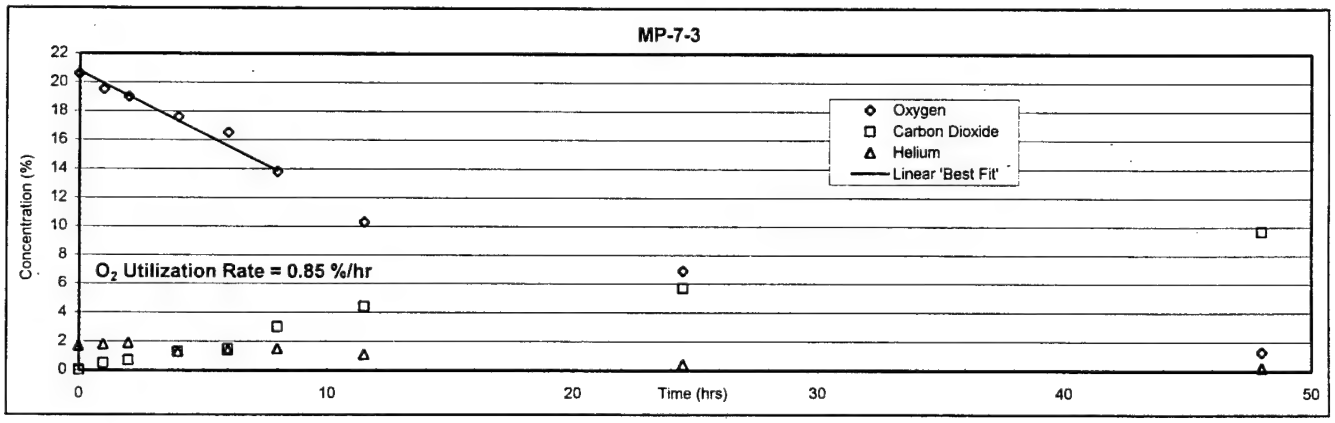


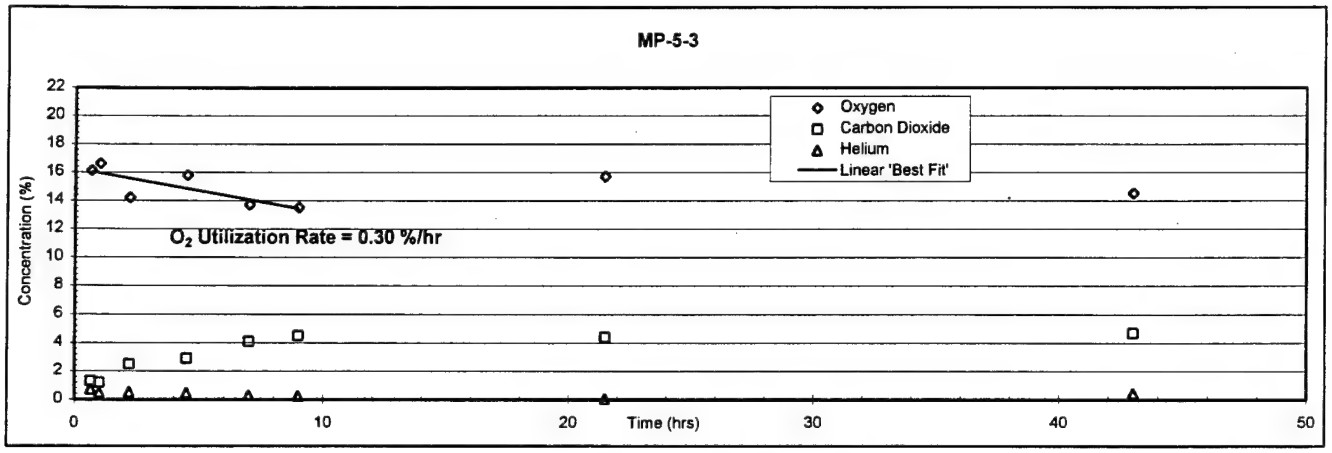
Figure A-9 Spring 1998 Respiration Test Results for MP-6-3 and MP-7-3 at the FJETC

Time[1] (hrs)	MP-5-3					MP-10-3				
	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)
Pretest[2]	13.9	9.4	8127	72	-	10.5	9.8	fo	25	-
0.0										
0.7	16.1	1.3	1429	75	0.73	19.5	0.5	29	8	2.3
1.0	16.6	1.2	1260	79	0.48	19.2	0.5	27	5	2
2.2	14.2	2.5	1871	45	0.51	18.6	1.1	59	8	2.3
4.5	15.8	2.9	1575	74	0.44	17.5	1.5	73	11	1.8
7.0	13.7	4.1	2129	75	0.28	16.6	2.3	48	7	1.7
9.0	13.5	4.5	2221	96	0.22	16	2.5	45	20	1.5
21.5	15.7	4.4	fo	101	0.04	13.7	3.9	22	4	0.59
43.0	14.5	4.7	fo	128	0.43	8.9	5.7	fo	16	0.1
71.0	15.2	5.3	440	35	0	8.1	6.2	fo	44	0.01
	End of Test					End of Test				

[1] Test began on 6/29/98 at 1330 hrs. fo = flame out

[2] Pretest sample is collected before air/helium injection and after system was shutdown on 6/28/98 at 1830 hrs.

Note: Typical background oxygen utilization rates = 0.06 - 0.10 %/hr.



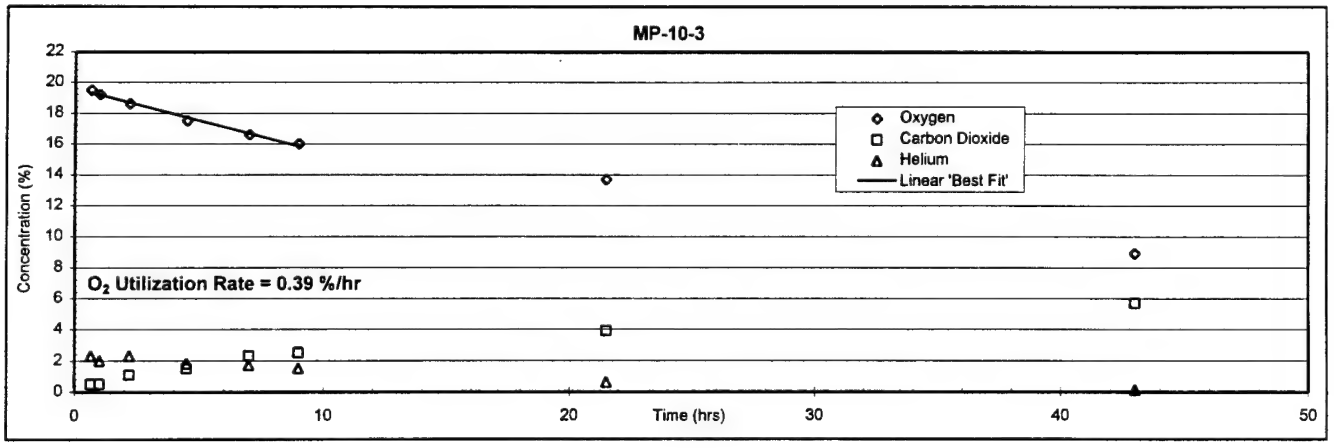


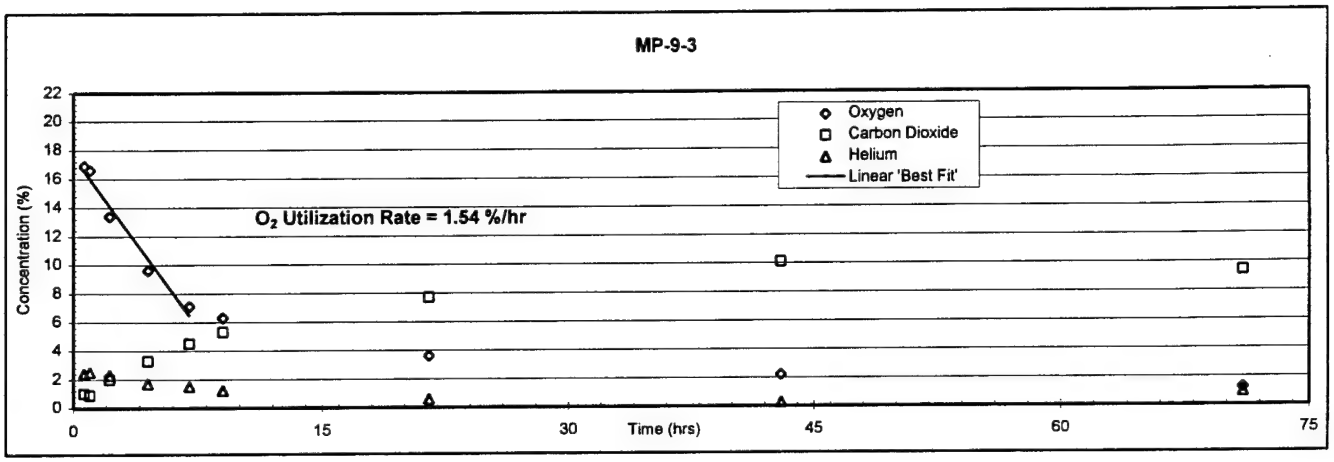
Figure A-10 Spring 1998 Respiration Test Results for MP-5-3 and MP-10-3 at the FTA

Time[1] (hrs)	MP-9-3					MP-9-10				
	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)
Pretest[2]	3.7	13.7	fo	206	-	18	1.4	1020	175	-
0.0										
0.7	16.9	1	197	56	2.4	19.9	0.2	98	30	2.2
1.0	16.6	0.9	138	38	2.5	19.5	0.3	119	39	2.3
2.2	13.4	2	232	71	2.3	19.5	0.4	113	37	2.6
4.5	9.6	3.3	fo	87	1.7	19.1	0.5	255	48	1.8
7.0	7.1	4.5	fo	120	1.5	18.8	0.6	219	50	1.7
9.0	6.3	5.3	fo	139	1.2	18.6	0.7	225	55	1.6
21.5	3.6	7.7	fo	212	0.56	18.5	1	262	69	0.68
43.0	2.2	10.1	fo	121	0.24	18	1.1	313	78	0.39
71.0	1.2	9.4	fo	512	0.91	17.6	2	352	102	0.29
	End of Test					End of Test				

[1] Test began on 6/29/98 at 1330 hrs. fo = flame out

[2] Pretest sample is collected before air/helium injection and after system was shutdown on 6/28/98 at 1830 hrs.

Note: Typical background oxygen utilization rates = 0.06 - 0.10 %/hr.



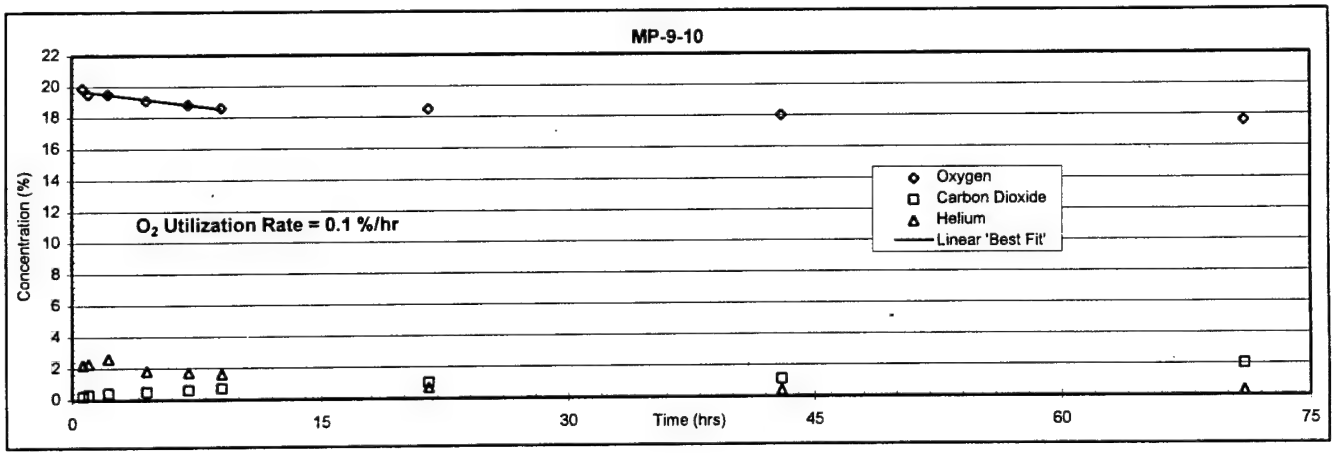


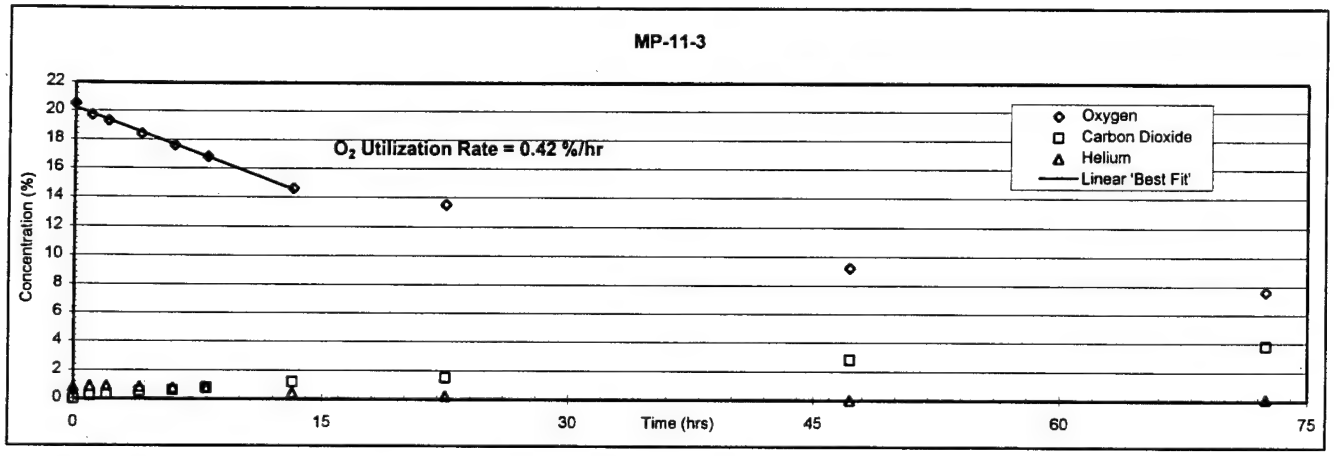
Figure A-11 Spring 1998 Respiration Test Results for MP-9-3 and MP-9-10 at the FTA

Time[1] (hrs)	MP-11-3					MP-12-6				
	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)
Pretest[2]	15.1	2	10	7	-	17.1	1.9	29	12	-
0.0	20.5	0	10	5	0.79	20.5	0	8	5	0.92
1.0	19.7	0.2	12	12	0.88	20.4	0.2	11	2	0.84
2.0	19.3	0.3	14	4	0.88	20.3	0.2	11	0	0.88
4.0	18.4	0.5	11	6	0.84	20.2	0.3	11	4	0.91
6.0	17.6	0.6	12	2	0.78	20.3	0.4	16	2	0.97
8.0	16.8	0.8	11	5	0.75	19.8	0.5	14	6	1.1
13.2	14.6	1.2	13	nt	0.42	19.3	0.5	14	nt	1.1
22.5	13.5	1.5	9	2	0.19	19.1	0.6	13	4	1.1
47.3	9.2	2.8	fo	7	0	18.1	0.9	16	5	1
72.5	7.6	3.8	fo	nt	0.1	16.4	1	12	12	1
	End of Test					End of Test				

[1] Test began on 6/30/98 at 0930 hrs. fo = flame out

[2] Pretest sample is collected before air/helium injection and after system was shutdown on 6/28/98 at 1830 hrs.

Note: Typical background oxygen utilization rates = 0.06 - 0.10 %/hr.



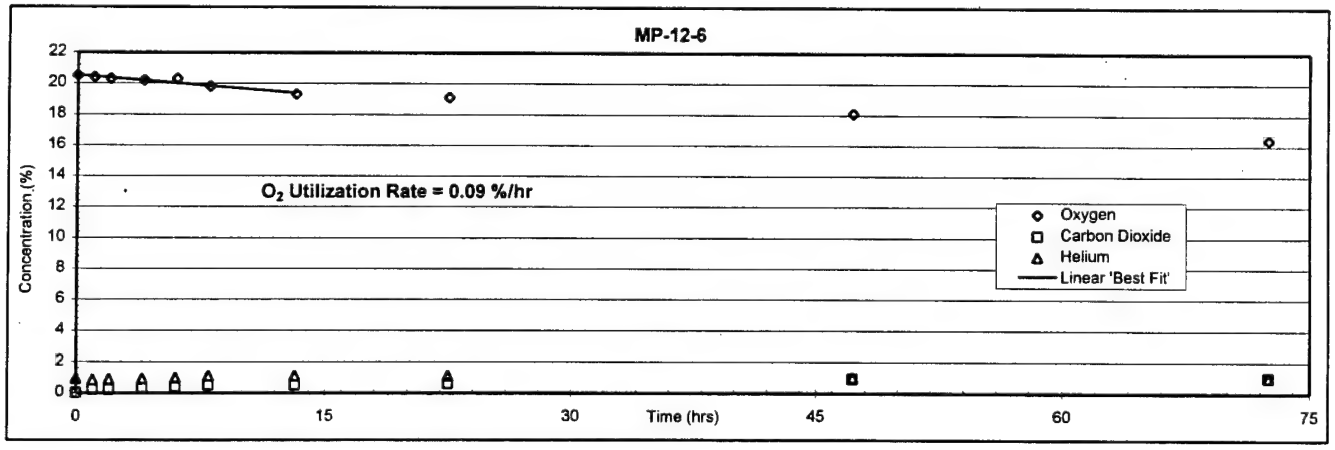


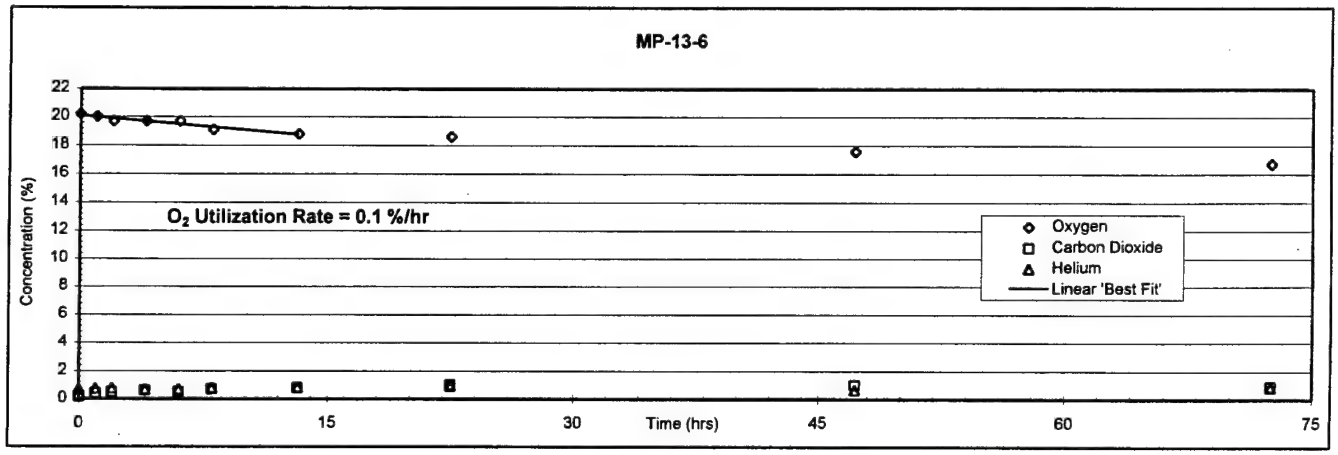
Figure A-12 Spring 1998 Respiration Test Results for MP-11-3 and MP-12-6 at the FTA

Time[1] (hrs)	MP-13-6					MP-1-6				
	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)
Pretest[2]	7.7	8	fo	38	-	14.2	3.8	318	111	-
0.0	20.2	0.2	23	22	0.7	20.3	0.4	115	41	0.78
1.0	20	0.4	35	34	0.74	20	0.6	206	84	0.76
2.0	19.7	0.5	35	10	0.77	19.7	0.8	208	46	0.73
4.0	19.7	0.6	31	9	0.71	19.4	1	208	53	0.73
6.0	19.7	0.5	45	21	0.71	19.2	1.2	220	55	0.79
8.0	19.1	0.7	36	14	0.8	18.6	1.3	180	61	0.81
13.2	18.8	0.8	36	nt	0.83	17.8	1.3	174	nt	0.91
22.5	18.6	1	34	10	0.93	16.7	1.8	222	68	0.86
47.3	17.6	1	117	27	0.66	14.4	1.9	165	96	0.71
72.5	16.7	0.9	78	78	0.85	12.1	2	112	132	0.8
	End of Test					End of Test				

[1] Test began on 6/30/98 at 0930 hrs. fo = flame out

[2] Pretest sample is collected before air/helium injection and after system was shutdown on 6/28/98 at 1830 hrs.

Note: Typical background oxygen utilization rates = 0.06 - 0.10 %/hr.



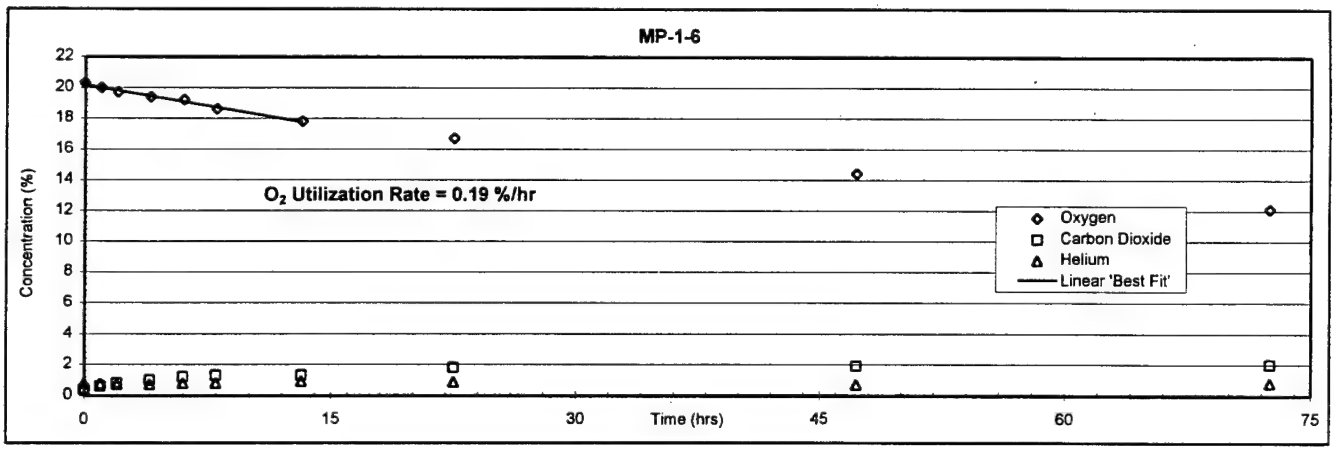


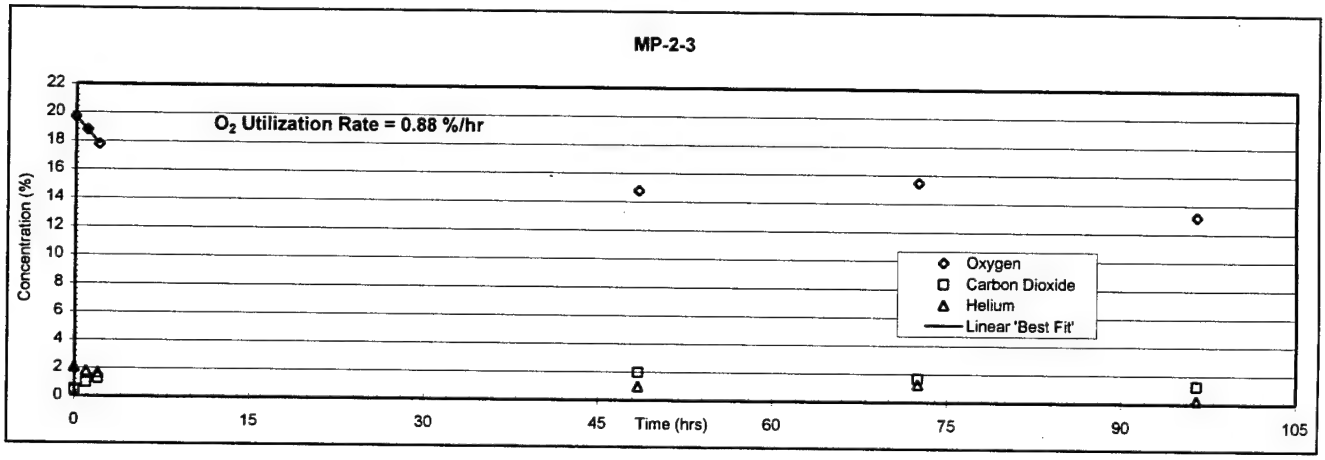
Figure A-13 Spring 1998 Respiration Test Results for MP-13-6 and MP-1-6 at the FTA

Time[1] (hrs)	MP-2-3					MP-3-6				
	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)
Pretest[2]	9.3	2.4	fo	3	-	12.5	1.4	81	28	-
0.0	19.7	0.5	17	6	2.1	19.3	0.6	11	4	2
1.0	18.8	1	32	16	1.8	18.5	0.9	7	20	1.7
2.0	17.8	1.3	16	10	1.7	18.1	1.1	11	7	1.8
4.0	Lost flow in MP-2-3					17.8	1.1	13	15	1.6
6.0						17.6	1.2	12	10	1.7
8.0						17.4	1.2	16	60	2
11.1						17.2	1	27	nt	1.9
20.5						17	1.2	15	4	1.5
48.5	14.8	2	52	24	1	16.6	1.2	34	32	1.5
72.5	15.5	1.7	19	121	1.3	13.6	1.3	62	102	0.4
96.5	13.2	1.3	70	240	0.3	15.8	1.1	20	312	1
	End of Test					End of Test				

[1] Test began on 6/30/98 at 1145 hrs. fo = flame out

[2] Pretest sample is collected before air/helium injection and after system was shutdown on 6/28/98 at 1830 hrs.

Note: Typical background oxygen utilization rates = 0.06 - 0.10 %/hr.



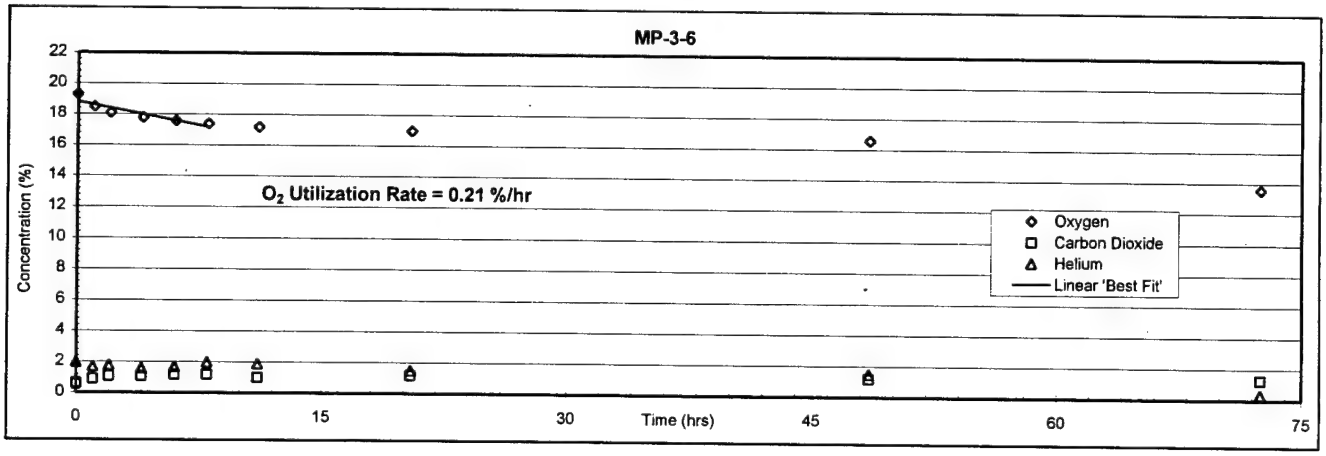


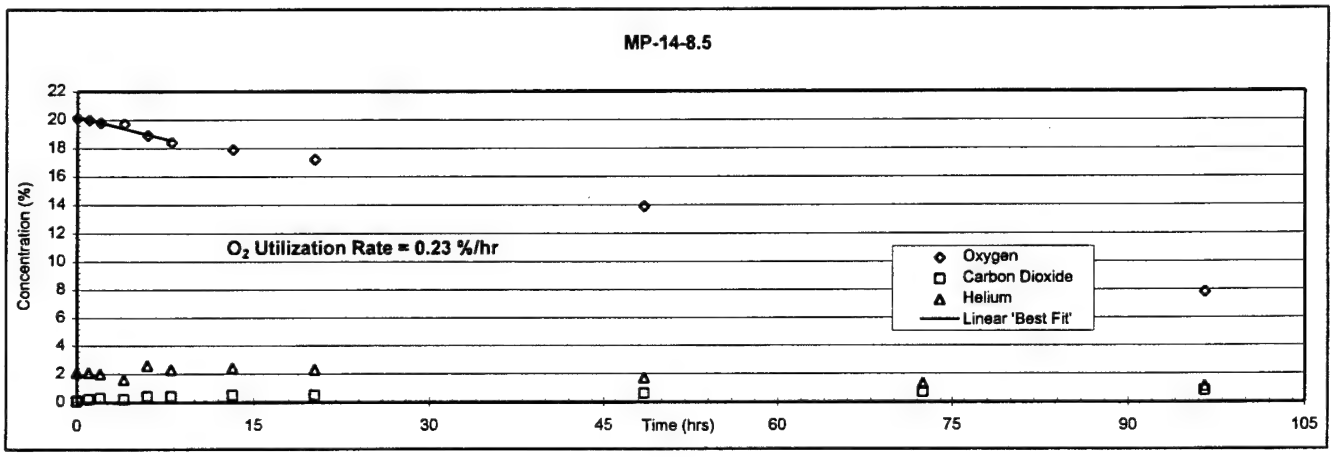
Figure A-14 Spring 1998 Respiration Test Results for MP-2-3 and MP-3-6 at the FTA

Time[1] (hrs)	MP-14-8.5					MP-15-10				
	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)
Pretest[2]	16.9	1.1	34	18	-	17.9	0.9	233	63	-
0.0	20.1	0.1	10	12	2.1	20	0.3	55	22	2.4
1.0	20	0.2	12	21	2.1	19.9	0.4	64	33	1.7
2.0	19.8	0.3	16	21	2	19.8	0.4	70	35	1.5
4.0	19.7	0.2	20	16	1.6	19.5	0.5	101	40	1.5
6.0	18.9	0.4	27	17	2.6	18.9	0.5	112	49	1.5
8.0	18.4	0.4	22	45	2.3	18.8	0.6	96	117	1.3
13.2	17.9	0.5	20	nt	2.4	18.4	0.6	93	nt	1.2
20.2	17.2	0.5	16	7	2.3	17.8	0.7	113	44	0.94
48.5	13.9	0.6	15	14	1.7	16	0.9	130	74	0.41
72.5	10.5	0.7	fo	nt	1.3	15.1	0.8	94	140	0.2
96.5	7.8	0.8	fo	nt	1.1	14.1	0.9	91	240	0.1
	End of Test					End of Test				

[1] Test began on 6/30/98 at 1145 hrs. fo = flame out

[2] Pretest sample is collected before air/helium injection and after system was shutdown on 6/28/98 at 1830 hrs.

Note: Typical background oxygen utilization rates = 0.06 - 0.10 %/hr.



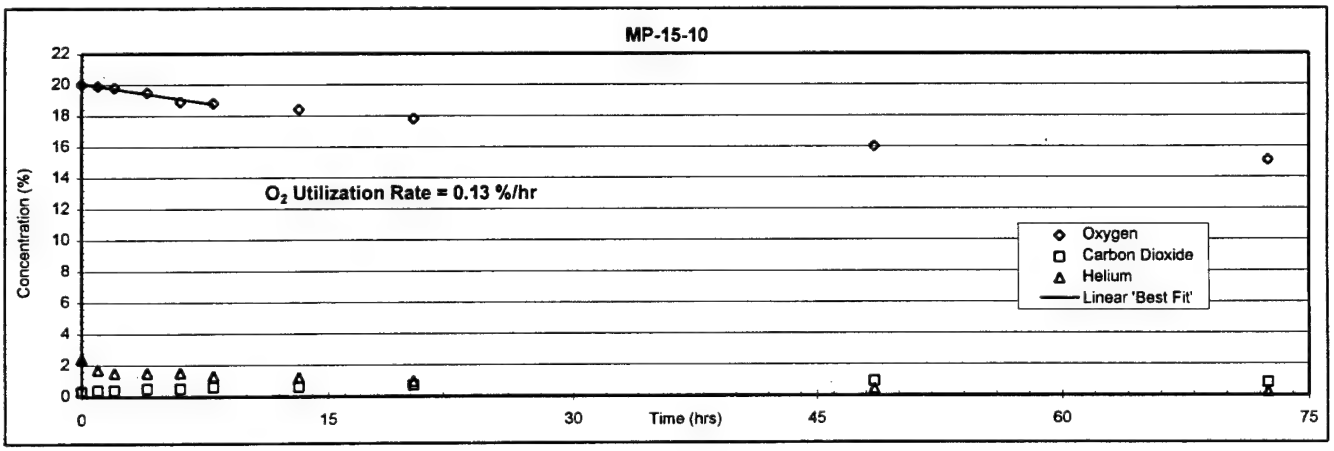


Figure A-15 Spring 1998 Respiration Test Results for MP-14-8.5 and MP-15-10 at the FTA

Time[1] (hrs)	MP-4BG				
	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	PID	Helium (%)
Pretest[2]	10.8	2.5	fo	2	-
0.0	20.1	0.3	5	13	2.6
1.0	19.6	0.7	7	17	2.5
2.0	18.9	1.3	5	7	2.3
4.0	18.2	1.4	5	2	2.4
6.5	17.6	1.8	6	20	2.4
9.6	17.1	1.9	6	nt	2.4
18.8	17	1.9	6	2	2
44.0	16.3	2.1	5	4	1.3
69.0	15.3	2.1	11	32	0.9
92.0	14.6	2.1	6	16	0.8
	End of Test				

[1] Test began on 6/30/98 at 1300 hrs. fo = flame out

[2] Pretest sample is collected before air/helium injection and after system was shutdown on 6/28/98 at 1830 hrs.

Note: Typical background oxygen utilization rates = 0.06 - 0.10 %/hr.

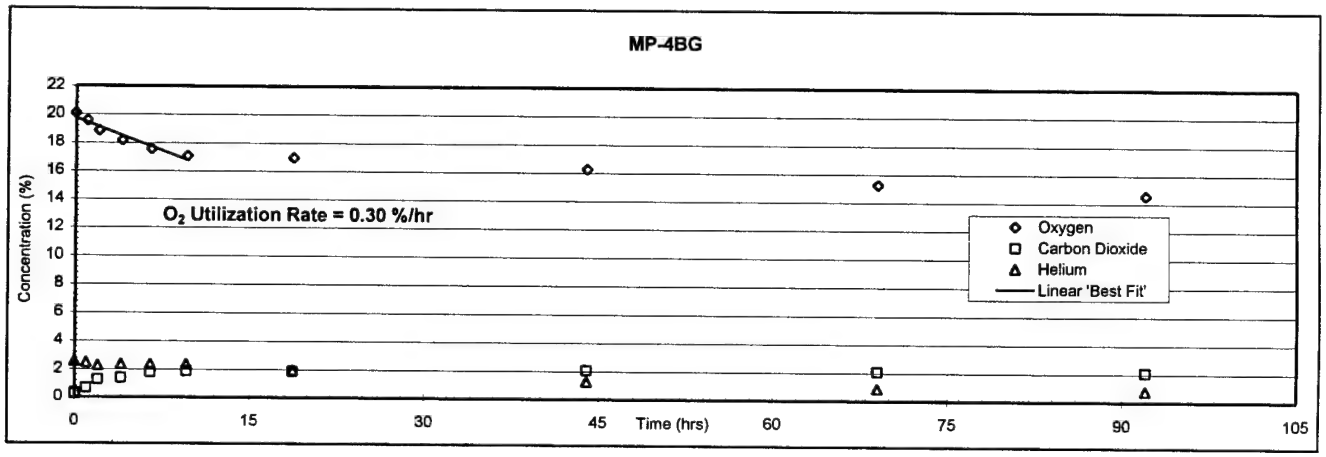


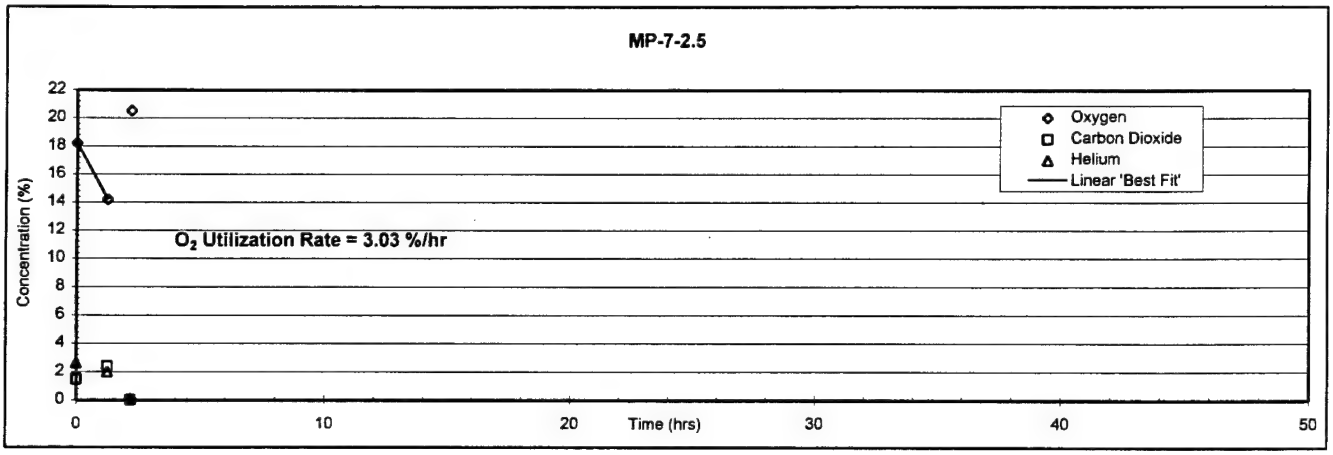
Figure A-16 Spring 1998 Respiration Test Results for MP-4BG at the FTA

Time[1] (hrs)	MP-7-2.5					MP-7-6.5				
	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)
Pretest[2]	10.8	10.2	8300	180	-	9	4.3	fo	125	-
0.0	18.2	1.5	>4.75%	475	2.6	16.1	2	>1.21%	255	2.7
1.3	14.2	2.4	fo	375	2	18.3	1	nt	nt	nt
2.2	20.5	0	1900	110	0.1	Test Abandoned (air flow stopped therefore minimal final sample)				
	Test Abandoned (no air flow) (3rd sample very low air)									

[1] Test began on 6/29/98 at 1100 hrs. fo = flame out

[2] Pretest sample is collected before air/helium injection and after system was shutdown on 6/26/98 at 1630 hrs.

Note: Typical background oxygen utilization rates = 0.06 - 0.10 %/hr.



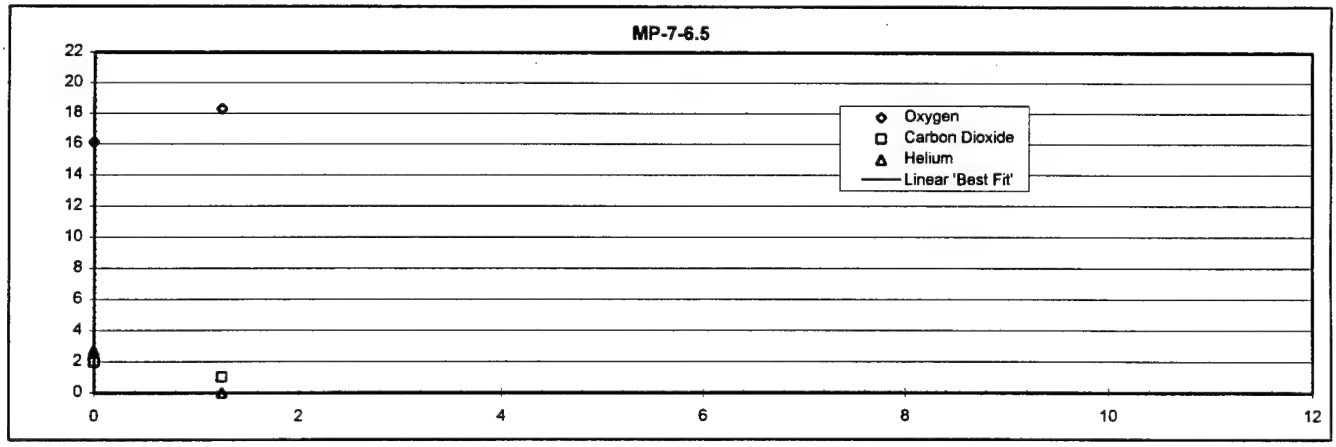
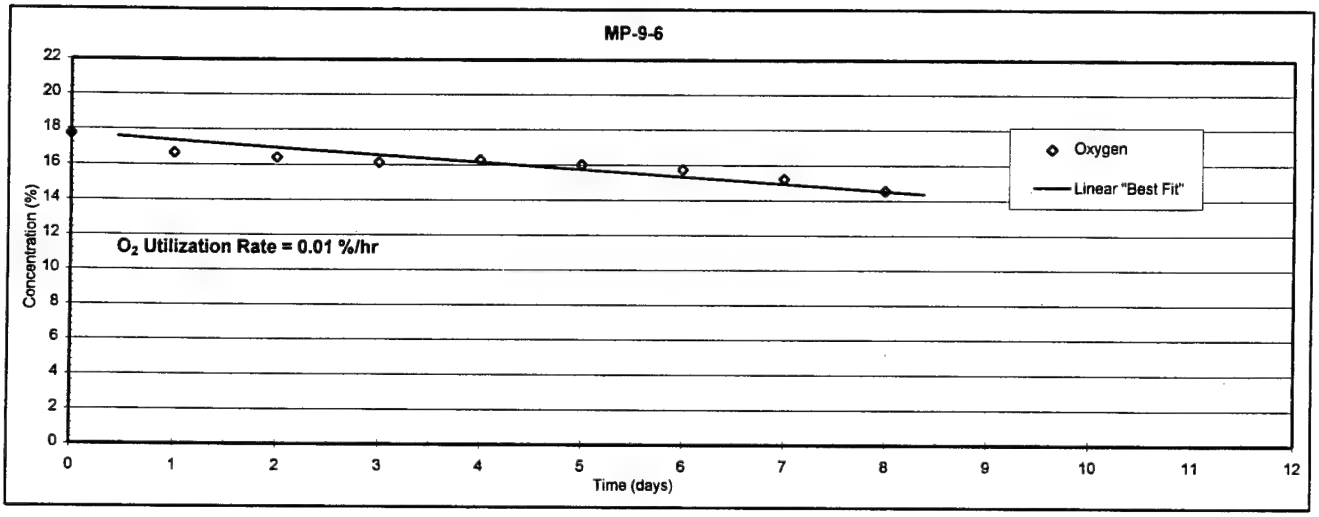


Figure A-17 Spring 1998 Respiration Test Results for MP-7-2.5 and MP-7-6.5 at the FTF

	Time (days)	MP-9-6 O_2 %
System off 2-10-98 1000 hrs	0	17.73
	1	16.667
	2	16.40
System on 2-13-98 1415 hrs	3	16.137
	4	16.27
	5	16.005
	6	15.74
	7	15.212
	8	14.55



Note: Both MPs contain oxygen sensors. The test was performed by simply turning off the blower and automatically recording the oxygen levels every hour.

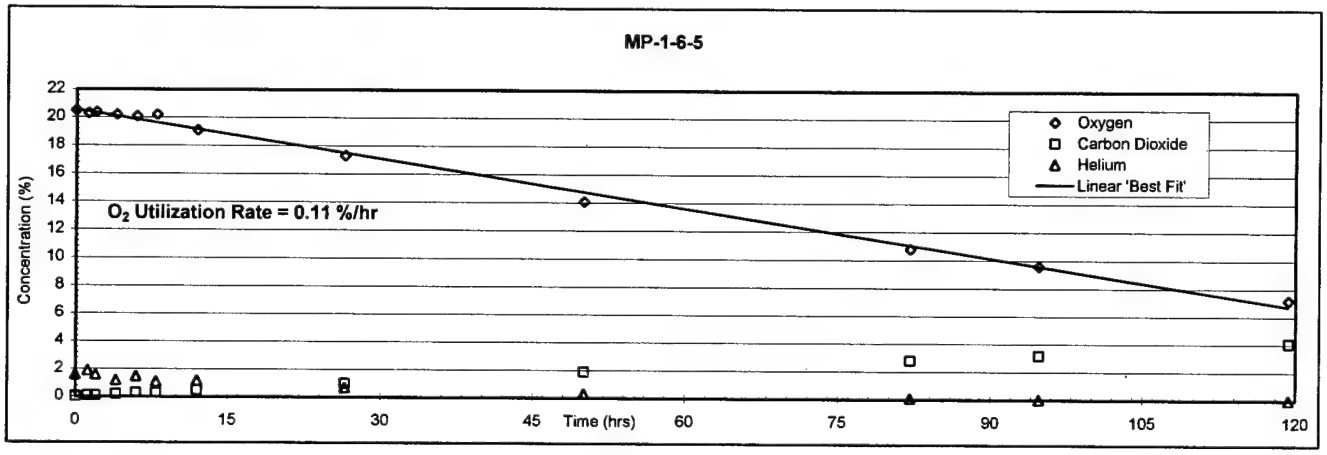
Figure A-18 Winter 1998 Respiration Test Results for MP-9-6 at the FTF II

Time[1] (hrs)	MP-1-6-5 O_2 (%)	CO_2 (%)	TVH (ppmv) FID	PID	Helium (%)	Time[1] (hrs)	MP-1-6-8.5 O_2 (%)	CO_2 (%)	TVH (ppmv) FID	PID	Helium (%)
Pretest[2]	18.3	1.1	3	4	-	Pretest[2]	9.6	4.1	fo	83.8	-
0.0	20.5	0	10	3	1.6	0.0	19.3	0.5	1.44%	270	2.2
1.2	20.3	0.1	13	3	1.9	1.2	15.4	1.4	3.80%	133	2
2.0	20.4	0.1	8	2	1.6	2.0	13.5	2	fo	124	2.8
4.0	20.2	0.2	9	2	1.2	4.0	15.2	1.4	fo	128	1.6
6.0	20.1	0.3	7	2	1.5	6.0	9.5	2.9	fo	159	2.2
8.0	20.2	0.3	7	1	1.1	8.0	11	2.6	fo	199	2.2
12.0	19.1	0.5	8	2	1.2	12.0	13.4	2.4	fo	350	1.9
26.5	17.3	1	5	1	0.71	26.5	7.6	3.9	fo	157	2.6
50.1	14.1	1.9	2	2	0.31	50.1	10.5	3.3	fo	211	1.4
82.1	10.8	2.8	2	3	0.1	50.4	10.8	3.2	fo	235	1.2
94.8	9.6	3.2	fo	2	0.03						
119.3	7.2	4.1	fo	0	nt						
		End of Test									

[1] Test began on 6/25/98 at 0835 hrs. fo = flame out

[2] Pretest sample is collected before air/helium injection and after system was shutdown on 6/22/98 at 1510 hrs.

Note: Typical background oxygen utilization rates = 0.06 - 0.10 %/hr.



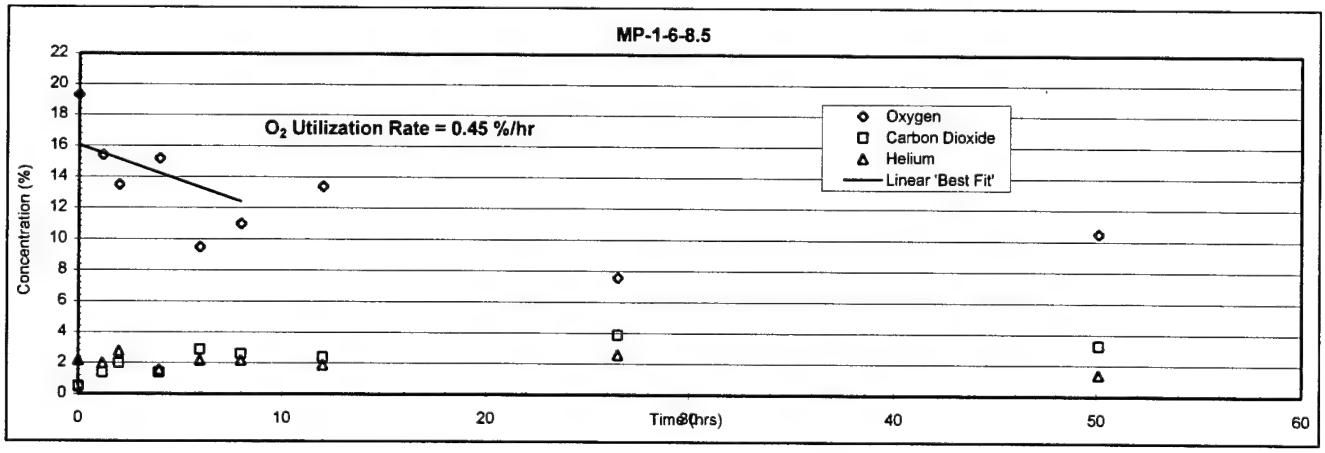


Figure A-19 Spring 1998 Respiration Test Results for MP-1-6-5 and MP-1-6-8.5 at NDA-1

Time[1] (hrs)	MP-6-2BG				
	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)
Pretest[2]	12.3	2.4	0	0	-
0.0					
0.5	20.5	0.2	6	2	1.7
1.6	20.1	0.5	32	4	1
2.6	19.9	0.5	8	2	1.2
4.5	19.7	0.6	20	5	1
7.1	19.5	0.8	20	13	0.84
22.5	18.9	1.1	10	18	0.86
33.5	18.6	1.2	7	11	0.54
46.3	18.1	1.3	4	3	0.46
58.8	17.4	1.5	11	3	0.56
72.0	17.6	1.4	1	3	0.5
96.0	16.1	2.1	3	2	0.53
119.0	18.6	1.1	17	20	0.26
	End of Test				

[1] Test began on 6/27/98 at 0900 hrs. fo = flame out

[2] Pretest sample is collected before air/helium injection and after system was shutdown on 6/24/98 at 1100 hrs.

Note: Typical background oxygen utilization rates = 0.06 - 0.10 %/hr.

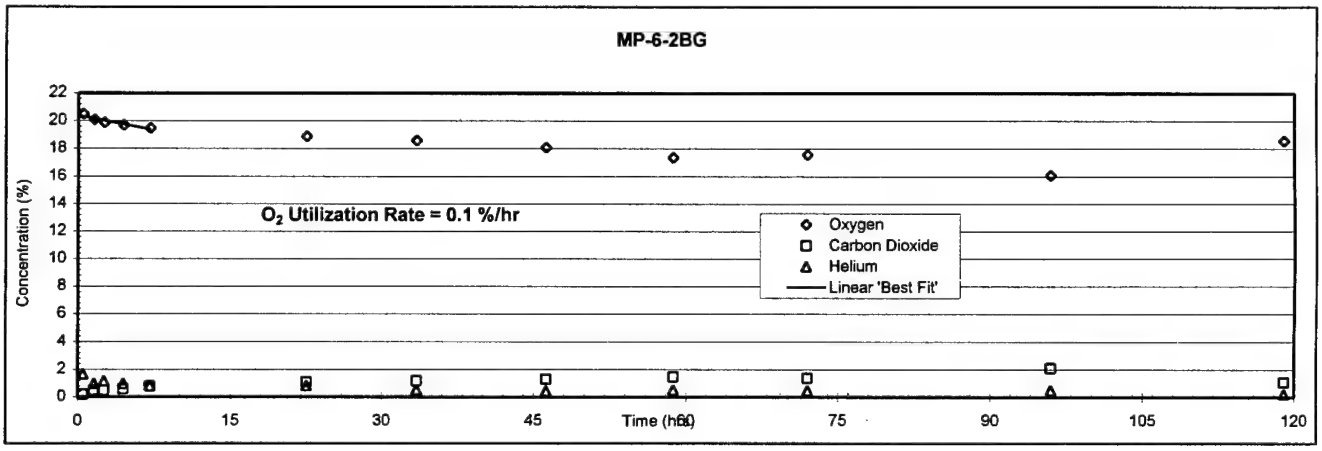


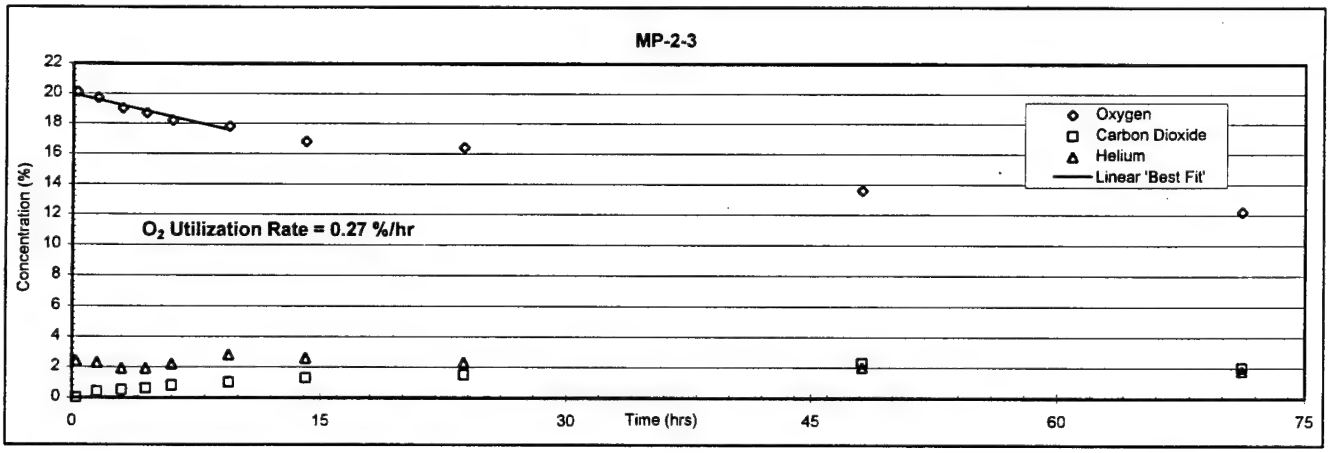
Figure A-20 Spring 1998 Respiration Test Results for MP-6-2BG at the NDA-6

Time[1] (hrs)	MP-2-3					MP-2-6				
	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)
Pretest[2]	9.8	3.2	fo	8	-	13.8	1.7	151	25	-
0.0										
0.3	20.1	0	36	11	2.4	20	0	40	9	2.4
1.5	19.7	0.4	29	6	2.3	19.9	0.2	39	7	2.3
3.0	19	0.5	22	8	1.9	19.6	0.4	73	10	1.7
4.5	18.7	0.6	32	8	1.9	19.6	0.4	78	14	1.6
6.0	18.2	0.8	22	16	2.2	19.3	0.5	62	16	1.8
9.5	17.8	1	49	4	2.8	19.1	0.5	119	10	1.9
14.1	16.8	1.3	41	12	2.6	18.7	0.7	97	15	1.7
23.8	16.4	1.5	36	8	2.3	19	0.6	water	water	water
48.2	13.6	2.3	51	3	2	End of Test				
71.2	12.2	2	58	16	1.8					
End of Test										

[1] Test began on 6/29/98 at 0900 hrs. fo = flame out

[2] Pretest sample is collected before air/helium injection and after system was shutdown on 6/22/98 at 1720 hrs.

Note: Typical background oxygen utilization rates = 0.06 - 0.10 %/hr.



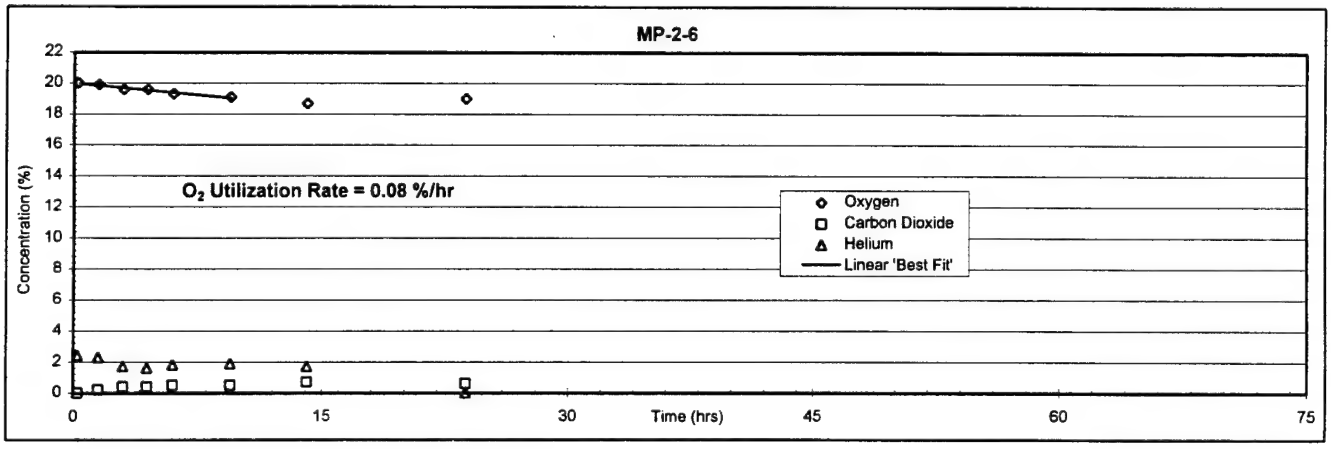


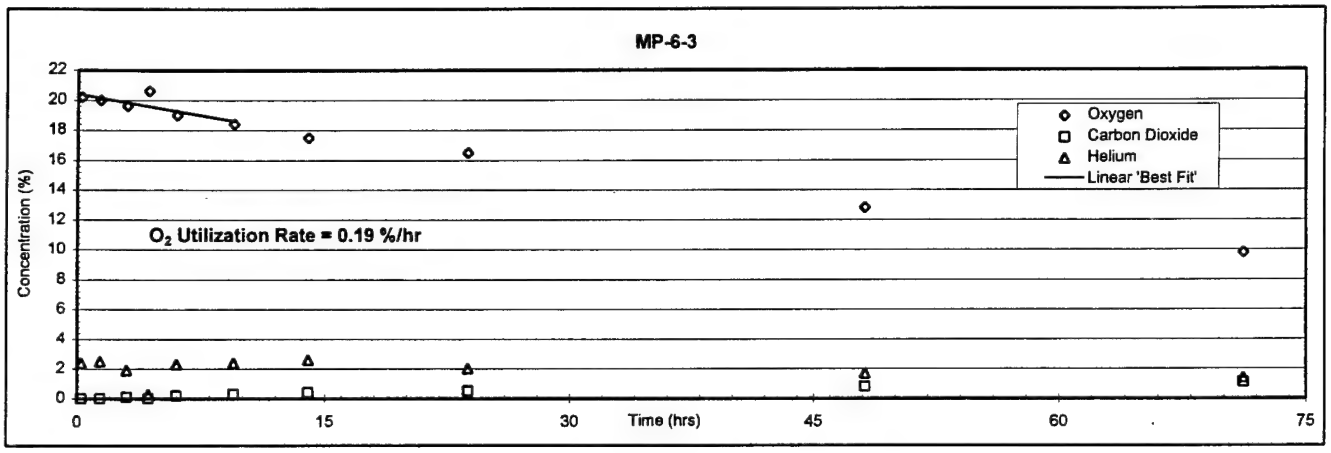
Figure A-21 Spring 1998 Respiration Test Results for MP-2-3 and MP-2-6 at the PPDP

Time[1] (hrs)	MP-6-3					MP-8-3				
	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)
Pretest[2]	8.1	0.8	fo	2	-	15.5	2.6	6	2	-
0.0										
0.3	20.2	0	2	3	2.4	20.4	0	2	3	2.2
1.4	20	0	6	2	2.5	20.2	0.1	2	3	2
3.0	19.6	0.1	8	3	1.9	20	0.2	5	2	1.2
4.3	20.6	0	6	3	0.29	20.6	0	9	4	0.25
6.0	19	0.2	9	2	2.3	19.7	0.3	7	3	1.3
9.5	18.4	0.3	14	1	2.4	19.4	0.5	7	1	0.86
14.0	17.5	0.4	19	7	2.6	18.7	0.7	11	7	0.61
23.8	16.5	0.5	7	0	2	18.7	1	2	0	0.2
48.2	12.8	0.8	5	0	1.7	16.9	1.2	4	1	0.01
71.2	9.8	1.1	fo	11	1.4	16.7	1.3	7	23	0
	End of Test					End of Test				

[1] Test began on 6/29/98 at 0900 hrs. fo = flame out

[2] Pretest sample is collected before air/helium injection and after system was shutdown on 6/22/98 at 1720 hrs.

Note: Typical background oxygen utilization rates = 0.06 - 0.10 %/hr.



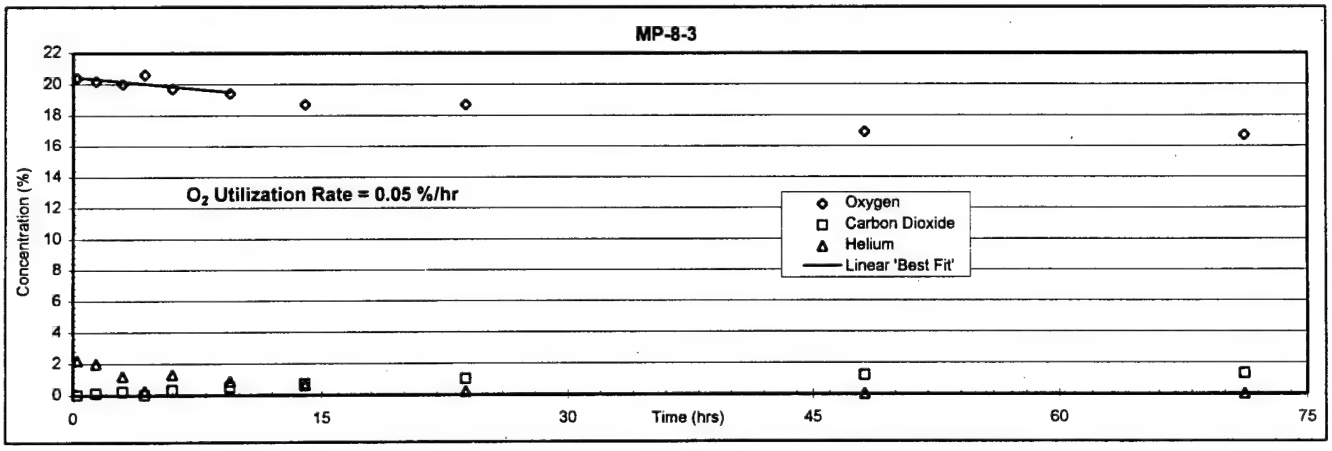


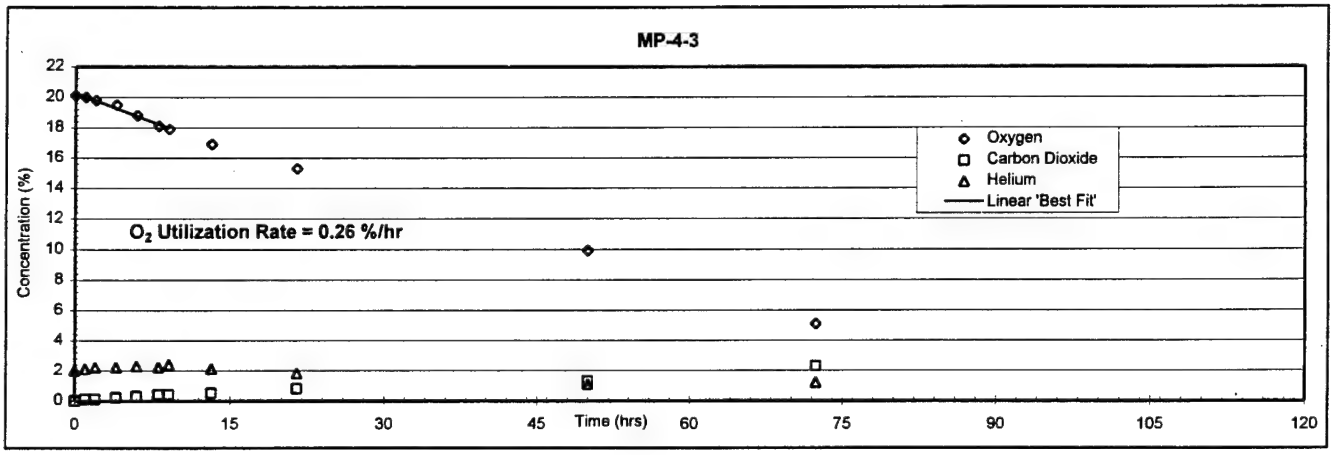
Figure A-22 Spring 1998 Respiration Test Results for MP-6-3 and MP-8-3 at the PPDP

Time[1] (hrs)	MP-4-3					MP-9-9				
	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)
Pretest[2]	13.1	1	4	1	-	17.5	1.8	1511	5	-
0.0	20.1	0	8	4	2	20.1	0	38	7	2.1
1.0	20	0.1	9	3	2.1	19.9	0.3	210	3	1.1
2.0	19.8	0.1	9	2	2.2	19.7	0.4	255	2	1
4.0	19.5	0.2	11	2	2.2	19.4	0.6	216	2	1
6.0	18.8	0.3	12	20	2.3	18.2	1	389	18	1
8.1	18.1	0.4	13	6	2.2	17.9	1.2	382	8	0.86
9.1	17.9	0.4	13	6	2.4	17.9	1.3	460	8	0.8
13.2	16.9	0.5	17	20	2.1	17.1	1.5	506	28	0.82
21.5	15.3	0.8	18	1	1.8	17.1	1.7	325	3	0.44
50.0	9.9	1.3	fo	2	1.1	12.1	4	fo	3	0.37
72.4	5.1	2.3	fo	2	1.2	16.7	2.3	316	1	0.19
120.0	End of Test					14.2	2.8	268	3	0.1
						End of Test				

[1] Test began on 6/24/98 at 1000 hrs. fo = flame out

[2] Pretest sample is collected before air/helium injection and after system was shutdown on 6/22/98 at 1720 hrs.

Note: Typical background oxygen utilization rates = 0.06 - 0.10 %/hr.



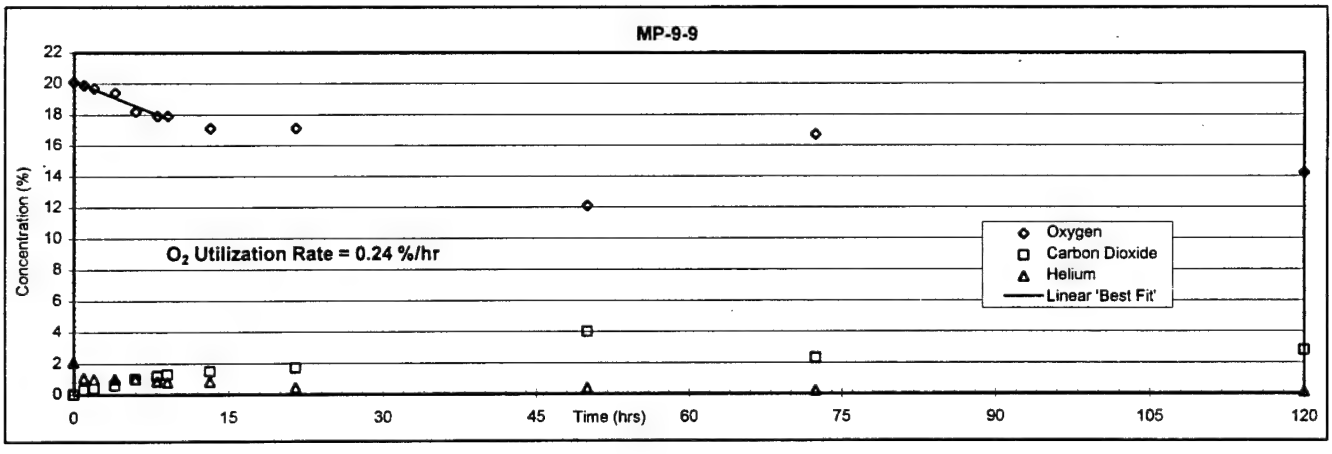


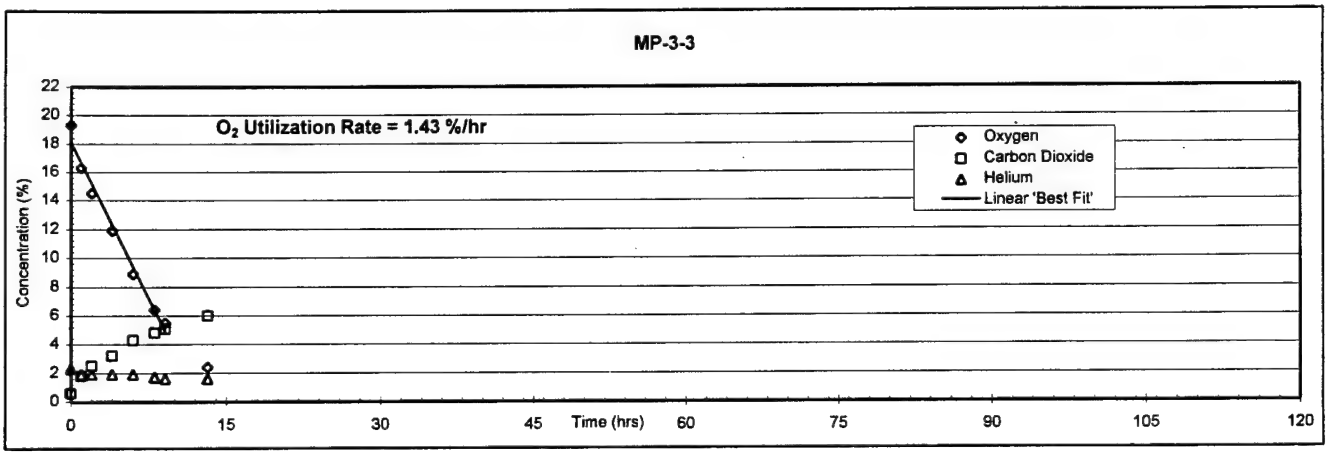
Figure A-23 Spring 1998 Respiration Test Results for MP-4-3 and MP-9-9 at the PPDP

Time[1] (hrs)	MP-3-3					MP-3-6				
	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)
Pretest[2]	1.2	11.6	fo	15	-	12.2	1.4	279	7	-
0.0	19.3	0.6	61	59	2.3	19.5	0.2	50	42	2.3
1.0	16.3	1.8	129	28	1.9	19.1	0.4	66	5	2.1
2.0	14.5	2.5	209	18	1.9	18.7	0.5	70	4	2.1
4.0	11.9	3.2	fo	13	1.9	18.4	0.6	68	3	2.4
6.0	8.9	4.3	fo	31	1.9	17.6	0.7	34	21	2
8.1	6.4	4.8	fo	59	1.7	16.8	0.8	49	20	2.1
9.1	5.5	5.1	fo	90	1.6	16.6	0.9	48	17	1.9
13.2	2.4	6	fo	105	1.6	15.8	1	59	26	2.1
21.5	End of Test					13.7	1.1	67	4	1.6
50.0						10.5	1.5	fo	8	0.81
72.4						7.2	2	fo	6	0.79
99.3						6.1	2.2	fo	9	0.71
119.6						6.9	2.1	End of Test	5	0.45

[1] Test began on 6/24/98 at 1000 hrs. fo = flame out

[2] Pretest sample is collected before air/helium injection and after system was shutdown on 6/22/98 at 1720 hrs.

Note: Typical background oxygen utilization rates = 0.06 - 0.10 %/hr.



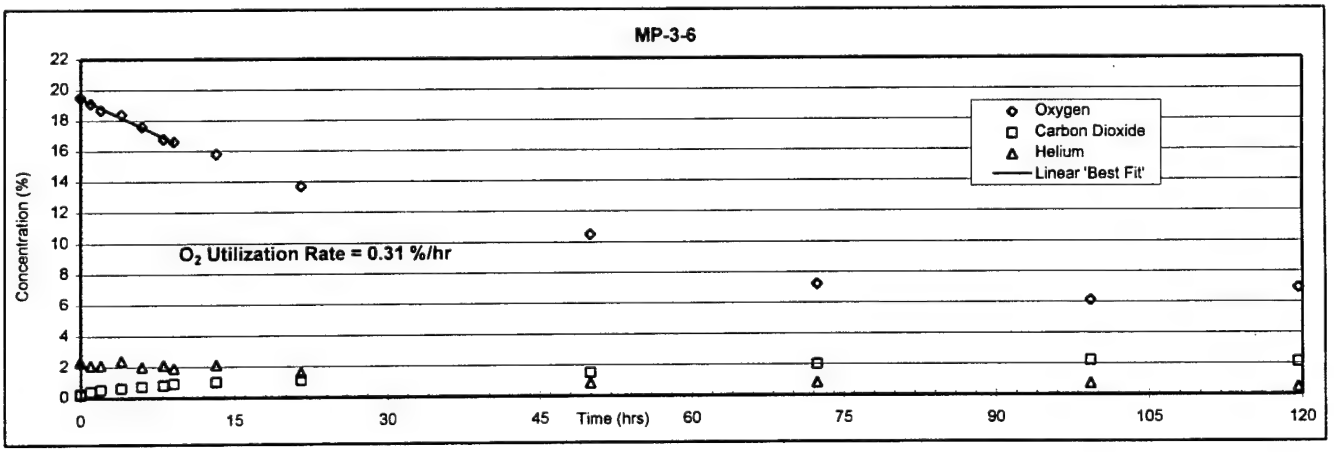


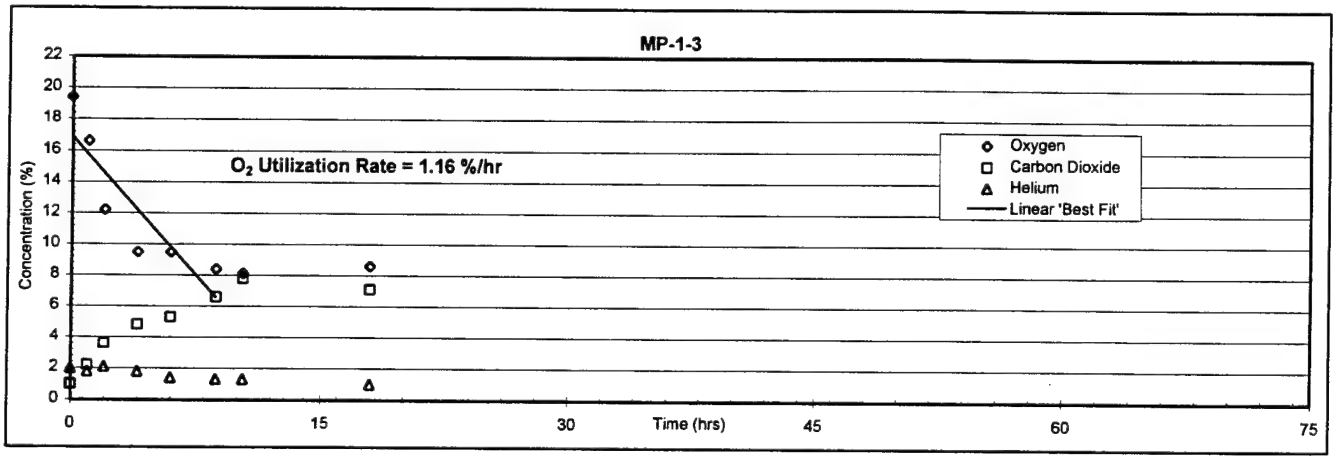
Figure A-24 Spring 1998 Respiration Test Results for MP-3-3 and MP-3-6 at the PPDP

Time[1] (hrs)	MP-1-3					MP-5-3				
	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)
Pretest[2]	12.7	10.3	fo	5	-	10.2	6.2	fo	6	-
0.0	19.4	1	267	25	2	20.1	0	49	24	1.4
1.0	16.6	2.2	813	3	1.8	19.7	0.5	76	5	1.5
2.0	12.2	3.6	1906	17	2.1	18.8	1.1	155	14	1.5
4.0	9.5	4.8	fo	69	1.8	18.2	1.4	220	18	1.5
6.0	9.5	5.3	fo	105	1.4	16.8	2.3	140	70	1.6
8.7	8.4	6.6	fo	32	1.3	15.6	2.8	122	56	1.7
10.3	8.1	7.8	fo	7	1.3	15.1	3.1	107	24	1.7
18.0	8.6	7.1	fo	105	1	15.2	2.6	87	6	1.1
47.0	End of Test					18.4	0.9	369	92	0.21
69.2						18.2	1.1	337	25	0.21
						End of Test				

[1] Test began on 6/24/98 at 1300 hrs. fo = flame out

[2] Pretest sample is collected before air/helium injection and after system was shutdown on 6/22/98 at 1720 hrs.

Note: Typical background oxygen utilization rates = 0.06 - 0.10 %/hr.



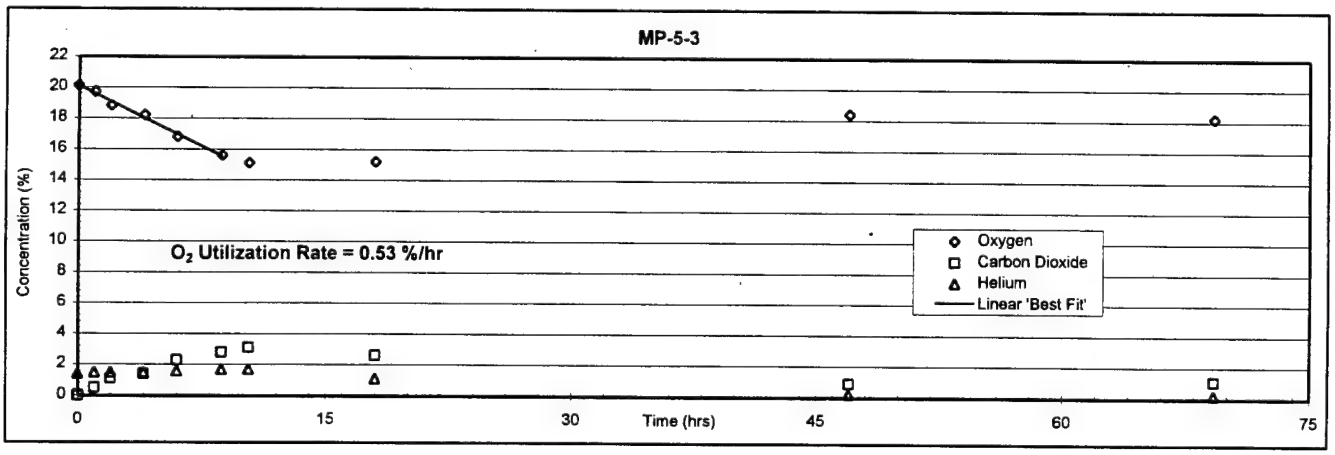


Figure A-25 Spring 1998 Respiration Test Results for MP-1-3 and MP-5-3 at the PPDP

Loring Air Force Base
Comments/Responses
Semi-Annual Biovent Performance Report, Jan-Jun 1998

Reviewer: Peter Forbes

Comments	Response
Item 1: General: Additional monitoring points or air injection wells are recommended for some sites. Let's discuss the cost and schedule for this work.	No response required.
Item 2: General: What causes "flame out" during measurement of TVH?	Flameout is caused primarily from low oxygen levels. Low oxygen levels are typically caused by active biodegradation and/or displacement due to methane.
Item 3, Section 1: I suggest a technical review of the listed references to achieve grammatical consistency. Some are listed as Final *Report* while others are listed as *Report,* Final. I suggest we drop the word "final" from the title of all the referenced reports. All the reports are final and it is only an indicator of report status.	The word final will be deleted. Draft or some other derivative of draft will be retained if that is the case.
Item 4, Section 2: Combining NDA-2 & NDA-3 and NDA-4 & NDA-5 are mentioned here in the maintenance section. We should also include a statement that these actions are in response or fulfillment of recommendations made in the previous semi-annual report. The response to all other recommendations should also be addressed in this report in the appropriate section.	Three primary recommendations were made in the last semiannual report. (1) Spring/summer confirmation sampling, (2) combine NDA blowers, and (3) winter respiration. A new paragraph at the end of section 2.0 explains confirmation sampling was scheduled to begin in July 1998 therefore the data will not be presented in this report and the following statement was added to the end of the last sentence in the third paragraph in section 2.0 and the end of the second sentence in the first paragraph of section 3.1.3: ".....in response to recommendations made in the previous semiannual report".

Comments/Responses
Semi-Annual Biovent Performance Report, Jan-Jun 1998

Comments	Response
Item 5, Table 3-3: The data are for 1998. Change the date in the title.	Title changed to (1/98 - 6/98).
Item 6, Section 4.2, Auto Hobby Shop: Add the location identifier "BH" to the numbers in the last sentence for consistency with Figure 4-1.	Comment incorporated.
Item 7, Section 4.2: I agree with the recommendation for additional injection wells.	No response required.
Item 8, Section 5.2, BX Service Station: Change "affect" to "effect" in the first paragraph.	Comment incorporated.
Item 9, Section 5.2: I agree with the recommendations.	No response required.
Item 10, Section 6.2, Entomology Shop: Re-write the sentence that begins "If contamination still exists". *If petroleum contamination still exists under the former basement, a residual risk assessment may be performed to determine if further action is necessary. If further action is required, installation of additional AIWs or excavation and ex-situ soil vapor extraction will be evaluated.*	Comment incorporated.

Comments/Responses
Semi-Annual Biovent Performance Report, Jan-Jun 1998

Comments	Response
Item 11, Section 7.2, FJETC: I agree with the written recommendations at this site. Are there any recommendations that will enable the system to run better through this winter?	Typically the winter oxygen injection rates are near design levels. The following recommendation has been added: "In addition, evaluate surface runoff features and relationship to the gravel beds just southeast of the FJETC biovent building. Implement surface water management practices (i.e., polyliner) if it is thought that groundwater levels can be lowered."
Item 12, Section 8.2, Fire Training Area: I agree with the recommendations.	No response required.
Item 13, Section 9.1, Fuel Tank Farm: Review this paragraph for accuracy and verb tense.	The first sentence has been restructured to say "The FTF bioslurp/biovent system installed at OU11 is made up of 17 bioslurp wells, 21 biovent wells, and ....."
Item 14, Section 9.2, Fuel Tank Farm: There are not enough useful monitoring points at this site. Do we have any oxygen sensors to spare?	The following recommendation has been added: "Install up to 9 new AIWs where needed throughout the FTF II area. In addition, move up to 4 existing oxygen sensors to new locations."
Item 15, Section 9.2, Fuel Tank Farm: Table 9-1 indicates BV-11, BV-17, BV-20, BS-10 and BS-11 are "off" in April, May and June. Please explain in this section. Also missing the M in March and the format for June is different than the other months.	A footnote will be added to the bottom of the table that states that air injection was shut off at BV-11, BV-17, BV-20, BS-10, and BS-11 in order to allow the wells to fully hydrate before they were compromised. The June heading is different on purpose because the average flow was added to last column ..... 'June 1998' has been squeezed in now.
Item 16, Section 9.2, Fuel Tank Farm, Figure 9-1: The figure indicates several wells are "off". Please explain in the text.	This reason was added to the text in Section 9.2 and to all of the Air Flow and MP Data tables when appropriate.

Comments/Responses
Semi-Annual Biovent Performance Report, Jan-Jun 1998

Comments	Response
Item 17, Section 10, Fuel Tank Farm II: The column heading for June is different from the other months in Figure 10-1. Check this on all the air flow figures.	See response to Item 15.
Item 18, Figure 11-1, NDA: Add notes to the figure indicating the biovent support buildings at NDA-3 and NDA-4 were shut down in January 1998. Also show the newly established connections between the systems.	Notes and the newly established connections have been added to Figure 11-1.
Item 19, Section 11, NDA-1: I agree with the recommendations. After we evaluate the confirmation sample data, we will probably recommend new AIWs and MPs as well as shutting down portions of the system.	No response required.
Item 20, Section 12.2, NDA-2: Change MP-2 to MP 2-2 and MP-6 to MP 1-6 which corresponds to the labels used in the figures and tables.	Comment incorporated.
Item 21, Section 12.2, NDA-2: Monitoring point MP-2-11 has an oxygen sensor and should be used to perform a respiration test this fall. The confirmation data indicate that MP 2-11 is located in an area of contamination. The reduced oxygen levels at MP 2-11 are also evidence of low level biodegradation.	The 7th and 8th sentences of Section 12.2 now read: "The oxygen levels at the MP 2-11 oxygen sensor remained similar to those in the last half of 1997. A low oxygen level in MP 2-11 coupled with the low system-wide air injection rates during May suggest that biodegradation is occurring in the vicinity of MP 2-11."

Comments/Responses
Semi-Annual Biovent Performance Report, Jan-Jun 1998

Comments	Response
Item 22, Section 13.2, NDA-3: Low oxygen levels measured by the oxygen sensor at MP 3-3 indicate biodegradation is occurring there.	The following sentence has been added after the first sentence of Section 13.2: "The low oxygen level in MP 3-3 may also be evidence of low level biodegradation."
Item 23, Section 14.2, NDA-4: Table 14-1 indicates the oxygen sensor at MP 4-6 is malfunctioning. Has it been repaired or replaced? If it hasn't, we should discuss the location of additional monitoring points when we evaluate the confirmation sample data. The overall recommendation should be similar to that which is stated in Section 15.2, NDA-5.	The oxygen sensor is still malfunctioning. The decision to replace was deferred till the confirmation sampling evaluations are complete. The recommendations text matches the NDA-5 text.
Item 24, Section 15.2, NDA-5: I agree with the recommendation. Additional monitoring points will be needed if the system will run for any additional length of time.	No response required.
Item 25, Section 16.2, NDA-6: Since we already excavated this site due to the ineffective AIWs, we should state: *If AIWs 6-1, -3 and –4 are ineffective and residual contamination is found the site may be excavated.* In fact, we found high levels of petroleum contamination near the former valve pits, in an unmapped storm drain line and under the adjacent taxiway. These may explain the low oxygen levels measured in the monitoring points.	Your sentence has been added to the end of the recommendations text. Don't think it lets on to the fact that we already know the outcome.

Comments/Responses
Semi-Annual Biovent Performance Report, Jan-Jun 1998

Comments	Response
Item 26, Section 17.2, NDA-7: The confirmation data indicate the site meets cleanup goals. I recommend we state only that we will evaluate the site after the data are evaluated.	Comment incorporated. All but last sentence of the recommendations was deleted.
Item 27, Section 18.2, NDA-8: I agree with the recommendation. Change "effect" to "affect" in the second paragraph.	Comment incorporated.
Item 28, Table 18-1: Where are the data for MP 8-1?	MP 8-1 was not installed as indicated in the last semiannual report. A footnote at the bottom of this table will be added to identify this.
Item 29, Section 19, Power Plant Drainage Pipe: I agree with the recommendation. The soil gas monitoring point data indicates residual contamination. The confirmation data indicates we have met cleanup goals. It cannot be decommissioned until the regulators agree with our assessment. What about the indication of contamination at the background location? I think we should have sampled there also.	Similar situation as FTA but both of these locations are quite far from the identified contamination. All biovent sites did not have proposed confirmation sampling in the background area. NDA-6 likely should have had confirmation sampling in the background area too. It may be possible to add some locations in these areas before the end of the season.
Item 30, General: Please edit the text to use the long identifiers from Figure 11-1 when referencing the monitoring points in the Nose Dock Area.	Comment incorporated. The NDA identifier and the location number will be added to the text.

Comments/Responses
Semi-Annual Biovent Performance Report, Jan-Jun 1998

Reviewer: E. Thomas Joy (540) 557-6065

Comments	Response
1. Clarity and Organization The document is clearly written and well organized. WPI's review was greatly facilitated by the document's format, in which narrative sections, figures, and tables are grouped together for each bioventing system. General recommendations for enhancing the clarity of the document include:	
• Use the term monitoring point boring (MPB) and monitoring point (MP) to differentiate between the boring in which the monitoring point is located and the actual monitoring point.	New term has not been added to text.
• Refer to air injection wells (AIWs) and MPs in all of the Nose Dock Areas by their complete designations, which should include the Nose Dock Area number as the first digit.	Comment incorporated.
• If applicable, on figures containing air flow vs. depth to ground water information, indicate that the data shown are only from the AIWs included in the section (transect) shown on the Site Layout diagram.	Comment incorporated.
These and other recommendations for enhancing the clarity of the document are identified in the following specific comments section.	

Comments/Responses
Semi-Annual Biovent Performance Report, Jan-Jun 1998

Comments	Response
2. Completeness The document is complete.	No response required.
3. Technical Issues In general, the conclusions presented in this document are conservative and suggest continuing present actions until the results of soil testing can be evaluated. WPI agrees with this approach, given the difficulties experienced in obtaining soil gas samples. If soil samples indicate that remedial goals are not being attained, evaluation of alternative remedial methods will be advisable. Several technical issues pertaining to individual bioventing systems are identified in the following specific comments section.	No response required.
Item 1, Page 17, Figure 4-1: AIW-7 is indicated as being at design flow, but it is actually below the design flow listed in Table 4-1. AIW-17 is indicted as being above design flow, but it is actually at the design flow listed in Table 4-1. WPI recommends changing the designations on the figure to agree with those in the table.	Comment incorporated.
Item 2, Page 23, Figure 5-1: Air injection (bioventing) wells BV-1, BV-2, and BV-3 are indicated as being below design flow, but they are actually above the design flows listed in Table 5-1. WPI recommends changing the designations on the figure to agree with those in the table.	Comment incorporated.

Comments/Responses
Semi-Annual Biovent Performance Report, Jan-Jun 1998

Comments	Response
Item 3, Page 27, 3rd paragraph, Line 6: The sentence states, "AIW-3 was partially inundated in January and April...." However, Table 6-2 and Figure 6-2 indicate that AIW-3 was entirely inundated in January and April. WPI recommends addressing this discrepancy.	Comment incorporated.
Item 4, Page 39, 5th paragraph, Lines 6&7: The paragraph states that the Fire Training Area (FTA) bioventing system is operating as designed, that biodegradation appears to be occurring, and that background rates may soon be obtained. It then concludes that, based on the results of soil sampling in the summer of 1998, soils remaining above preliminary remediation goals (PRGs) should be evaluated for another remedial alternative. WPI recommends reconsidering or explaining this conclusion because it does not appear to be supported by preceding statements.	The second and third sentences of the 5th paragraph have been reworded to say: "Comparison of the Spring.....is still occurring although contamination may remain in various locations throughout the site. A decline in oxygen utilization rates since startup suggests enhanced biodegradation has occurred."
Item 5, Page 57, 6th paragraph, Lines 1&2: (A) The test states, "An increase in air flow near MP-6 is recommended, primarily by increasing air flow into AIWs 6, 4, and 2." This recommendation is confusing, because these wells are not located near MP-1-6. WPI recommends reevaluating this recommendation. (B) In order to prevent confusion, WPI recommends referring to AIWs and MPs in all of the Nose Dock Areas by their complete designations, which should include the Nose Dock Area number as the first digit.	This error has been corrected. AIWs 1-9, 1-10, and 1-23 replace the AIWs 6, 4, and 2 call outs. Comment incorporated.

Comments/Responses
Semi-Annual Biovent Performance Report, Jan-Jun 1998

Comments	Response
Item 6, Page 58, Figure 11-1: (A) The legend indicates that monitoring points with O_2 sensors are designated by a circle with the bottom half filled in and also by the letters "MP" followed by three groups of digits, e.g., MP-1-2-7. The use of these designators is not consistent on the figure. Some MPs indicated by half-filled circles are labeled with an "MP" followed by only two groups of digits, and in the data boxes for the individual bioventing systems, many monitoring points that apparently do not contain O_2 sensors are labeled with an "MP" followed by three groups of digits. WPI recommends addressing this issue.	The "4" was inadvertently left off some of the MP identifiers and has been corrected. All MP identifiers have been coded in the following manner: MP followed by the NDA site #, next the MP sequential number or location identifier, and finally the depth.
(B)The confusion described above appears to originate from the practice of using the term "monitoring point" and the designation "MP" to refer to both the actual monitoring point and the boring in which the monitoring point is located. WPI recommends using the terms monitoring point boring (MPB) and monitoring point (MP) to differentiate between the two.	See above.
(C)In the data box for NDA-1, one monitoring point is labeled MP-1-2-7-6. WPI recommends changing this to MP-1-2-7.6, if appropriate. If not, the final digit "6" should be explained.	The "6" is an error and should have been an "L". This has been corrected.
(D)In the data box for NDA-4, the initial digit "4" was apparently left out of the last several monitoring point designations. WPI recommends addressing this issue.	See response to A (item #6).

Comments/Responses
Semi-Annual Biovent Performance Report, Jan-Jun 1998

Comments	Response
Item 7, Page 83, 3rd paragraph, Lines 3&4: The text states, "Both AIW-7-1 and AIW-7-2 accepted air during the entire 6 months, although AIW-3 had problems in May and June (zero flow)." WPI recommends revising this sentence as follows to conform to Table 17-1: "Only AIW-7-2 accepted air during the entire 6 months. AIW-7-3 accepted air in all months except May and June."	Comment incorporated.
Item 8, Page 83, 4th paragraph, Line 2: The text refers to "newly available oxygen sensor data," but it is not clear if this is a reference to data presented in Table 17-1. WPI recommends addressing this issue.	All but the last sentence was deleted in response to comments made by Peter Forbes.
Item 9, Page 87, 2nd paragraph, Lines 3-5: The text states, "These areas are being sampled at a greater frequency of borings than the other portions of NDA-8 as shown on Figure 11-1." The meaning of this sentence is unclear and does not appear to be applicable to information presented on Figure 11-1. WPI recommends revising the sentence for clarity.	Sentence was removed since it is explained in the confirmation Field Sampling Plan.

Comments/Responses
Semi-Annual Biovent Performance Report, Jan-Jun 1998

Comments	Response
Item 10, Page 94, Figure 19-1: AIW-3 and AIW-17 are indicated as being at design flow, but they are actually below the design flow listed in Table 17-1. WPI recommends changing the designations on the figure to agree with those in the table.	Design flow is 4 scfm. The figure has been revised accordingly.
Item 11: If applicable, on figures containing air flow vs. depth to ground water information, indicate that the data shown are only from the AIWs included in the section (transect) shown on the Site Layout diagram.	Comment incorporated.